
I-40 EAST CORRIDOR PROFILE STUDY

I-17 TO ARIZONA/NEW MEXICO BORDER

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Draft Working Paper 6: Solution Evaluation and Prioritization

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PREPARED FOR:

Arizona Department of Transportation



PREPARED BY:



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LIST OF ABBREVIATIONS

Abbreviation	Name	Abbreviation	Name
AADT	Annual Average Daily Traffic	SR	State Route
ADOT	Arizona Department of Transportation	TI	Traffic Interchange
BCA	Benefit-Cost Analysis	TTI	Travel Time Index
CCTV	Closed Circuit Television	TTTI	Truck Travel Time Index
CS	Candidate Solution	UP	Underpass
DMS	Dynamic Message Sign	US	United States (Route)
EB	Eastbound	WB	Westbound
FY	Fiscal Year	WIM	Weigh-in-motion
I-40	Interstate 40		
I-17	Interstate 17		
I-19	Interstate 19		
I-10	Interstate 10		
I-8	Interstate 8		
IRI	International Roughness Index		
LCCA	Life Cycle Cost Analysis		
MP	Milepost		
MPD	Multi-Modal Planning Division		
OP	Overpass		
P2P	Planning to Programming		
PES	Performance Effectiveness Score		
PTI	Planning Time Index		
Rd	Road		
RWIS	Roadside Weather Information System		

1 INTRODUCTION

The Arizona Department of Transportation (ADOT) is the lead agency for this Corridor Profile Study of Interstate 40 (I-40) East between I-17 in Flagstaff and the New Mexico state line. This study will look at key performance measures relative to the I-40 corridor, and the results of this performance evaluation will be used to identify potential strategic improvements.

The intent of the corridor profile program, and of the Planning to Programming (P2P) process, is to conduct performance-based planning to identify areas of need and make the most efficient use of available funding to provide an efficient transportation network. ADOT is conducting eleven corridor profile studies. The eleven corridors are being evaluated within three separate groupings.

The first three studies (Round 1) began in spring 2014, and encompass:

- I-17: SR 101L to I-40
- I-19: Mexico International Border to I-10
- I-40: California State Line to I-17

The second round (Round 2) of studies, initiated in spring 2015, include:

- I-8: California State Line to I-10
- I-40: I-17 to the New Mexico State Line
- SR 95: I-8 to I-40

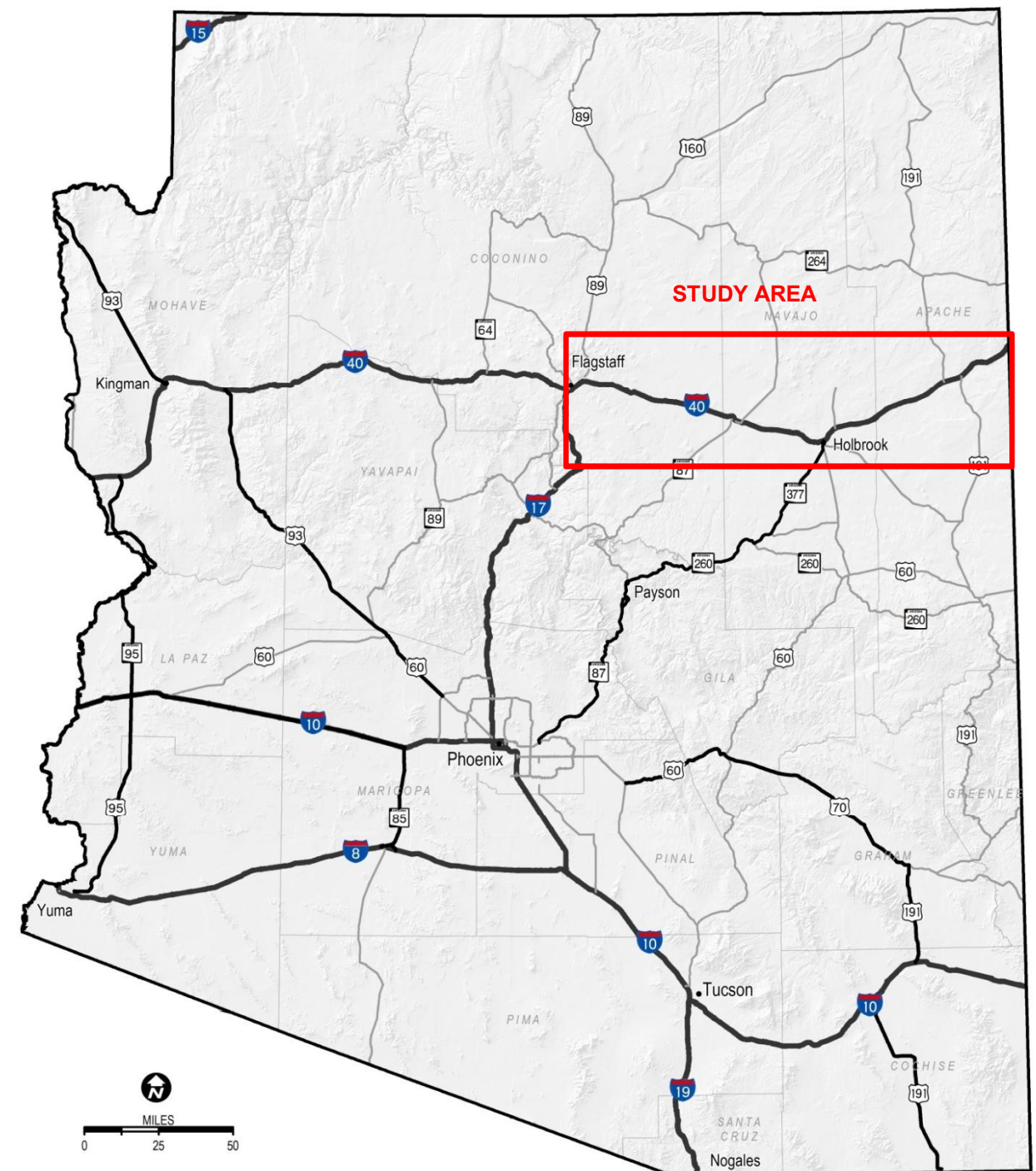
The third round (Round 3) of studies, initiated in fall 2015, include:

- I-10: California State Line to SR 85 and SR 85: I-10 to I-8
- I-10: SR 202L to the New Mexico State Line
- SR 87/SR 260/SR 377: SR 202L to I-40
- US 60/US 70: SR 79 to US 191 and US 191: US 70 to SR 80
- US 60/US 93: Nevada State Line to SR 303L

The studies under this program will assess the overall health, or performance, of the state's strategic highways. The Corridor Profile Studies will identify candidate solutions for consideration in the Multimodal Planning Division's (MPD) P2P project prioritization process, providing information to guide corridor-specific project selection and programming decisions.

I-40, I-17 to New Mexico State Line, depicted in **Figure 1**, is one of the strategic statewide corridors identified and is the subject of this Round 2 Corridor Profile Study.

Figure 1: Corridor Study Area



1.1 Corridor Study Purpose

The purpose of the I-40 Corridor Profile Study is to measure corridor performance to inform the development of strategic solutions that are cost-effective and account for potential risks. This purpose can be accomplished by following the process established by the previous Round 1 corridor profile study to:

- Inventory past improvement recommendations.
- Define corridor goals and objectives.
- Assess existing performance based on quantifiable performance measures.
- Propose various solutions to improve corridor performance.
- Identify specific solutions that can provide quantifiable benefits relative to the performance measures.
- Prioritize solutions for future implementation.

1.2 Corridor Study Goals and Objectives

The objective of this study is to identify a recommended set of potential strategic solutions for consideration in future construction programs, derived from a transparent, defensible, logical, and replicable process. The I-40 Corridor Profile Study will define solutions and improvements for I-40 that can be evaluated and ranked to determine which investments offer the greatest benefit to the corridor in terms of enhancing performance.

The following goals have been identified as the outcome of this study:

- Link project decision-making and investments on key corridors to strategic goals
- Match solutions with deficiencies in measured performance
- Prioritize improvements that cost-effectively preserve, modernize, and expand transportation infrastructure

1.3 Working Paper 6 Overview

The objective of Working Paper #6 is to document the evaluation of the strategic solutions identified for the I-40 Corridor. Pavement and bridge solutions will be evaluated using a Life-Cycle Cost Analysis (LCCA). In addition, this evaluation will include a risk-based performance effectiveness evaluation on each recommendation to determine the amount of benefit to the performance scores each solution produces. The result of this evaluation will be a prioritized list of recommendations for the I-40 corridor.

1.4 Corridor Overview

The I-40 corridor is a major east-west transcontinental interstate highway that connects the east coast (North Carolina) to the west coast (California). I-40 is a major transportation artery route for freight as well as passenger vehicular traffic, connecting major metropolitan cities in the south-western United States. I-40 is also the primary transportation route connecting the Phoenix metropolitan area to central and north-eastern parts of the country. I-40, together with I-17, plays a key role in the transportation infrastructure of northern Arizona, contributing to its economic success.

I-40 provides the most direct and fastest link between Flagstaff (and Grand Canyon National Park), central and north-eastern United States to the east, and major Californian Cities to the west (**Figure 1**). I-40 provides a principal road link for freight traffic from the ports in California. This study builds on earlier planning efforts in developing and applying a performance-based process for prioritizing improvements to meet present and future needs in the corridor.

1.5 Study Location and Corridor Segments

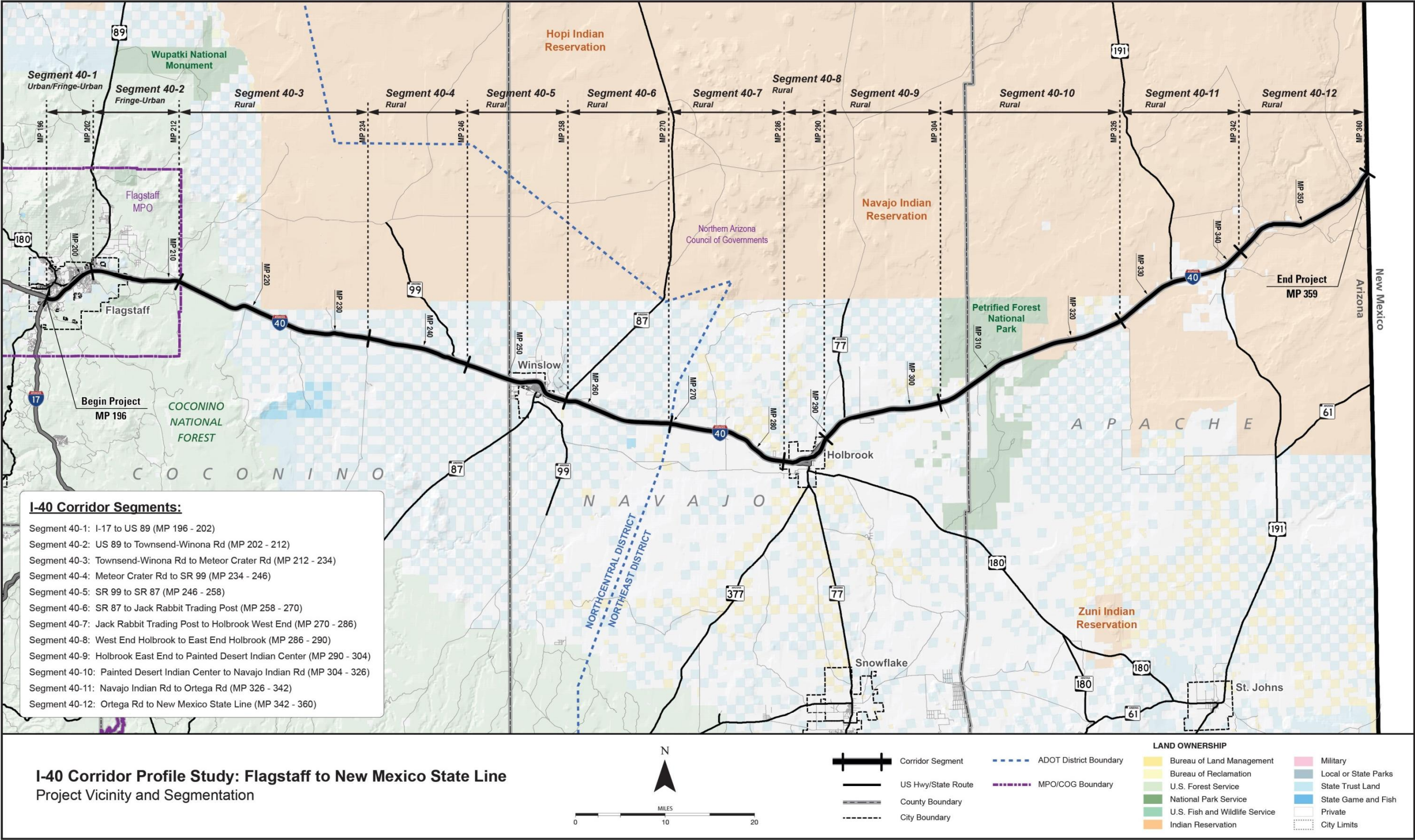
The I-40 corridor is being studied in two separate Corridor Profile Studies. One study extends from California to I-17 and this study extends from I-17 to New Mexico. For the purposes of this Corridor Profile Study, the portion from I-17 to New Mexico will be referred to as I-40 East.

The I-40 East corridor is 164 miles long, from I-17 (MP 196.0) to Arizona/New Mexico State Line (MP 360.0). The corridor has been divided into 12 distinct segments based on regionally significant intersecting routes, changes in topography, or natural or man-made landmarks along the corridor. The shortest segment is four miles long and the longest, a little over twenty-two miles. Corridor Segments have been described in **Table 1** below, and shown on a map in **Figure 2**.

Table 1: Corridor Segments and Descriptions

Segment #	Segment Description	Begin MP	End MP	Length (Miles)	Thru Lanes	2014 AADT (vpd)	Character Description
40-1	I-17 to US 89	196	202	6	4	37,684	This segment is generally urban/fringe-urban in nature, includes three interchanges, and is within the urbanized limits of the Flagstaff Metropolitan Area in Coconino County.
40-2	US 89 to Townsend-Winona Road	202	212	10	4	19,257	This segment is urban-fringe in nature, includes three interchanges, and is within Coconino County.
40-3	Townsend-Winona Road to Meteor Crater Road	212	234	22	4	15,468	This segment is generally rural in nature, includes four interchanges, and is within Coconino County.
40-4	Meteor Crater Road to SR 99	234	246	12	4	15,067	This segment is rural in nature, includes two interchanges, and within Coconino County.
40-5	SR 99 to SR 87	246	258	12	4	15,422	This segment is rural in nature, includes four interchanges, and spans Coconino and Navajo Counties. This segment passes through Winslow.
40-6	SR 87 to Jack Rabbit Trading Post	258	270	12	4	14,604	This segment is rural in nature, includes two interchanges, and is located within Navajo County.
40-7	Jack Rabbit Trading Post to Holbrook West End	270	286	16	4	14,916	This segment is rural in nature, includes four interchanges, and is located within Navajo County.
40-8	Holbrook West End to Holbrook East End	286	290	4	4	14,124	This segment is rural in nature, includes three interchanges, and is located within Navajo County. This segment passes through Holbrook.
40-9	Holbrook East End to Painted Desert Indian Center	290	304	14	4	16,674	This segment is rural in nature, includes four interchanges, and is located within Navajo County.
40-10	Painted Desert Indian Center to Navajo Indian Road	304	326	22	4	15,519	This segment is rural in nature, includes three interchanges, and spans Navajo and Apache Counties.
40-11	Navajo Indian Road to Ortega Road	326	342	16	4	14,719	This segment is rural in nature, includes three interchanges, and is located within Apache County.
40-12	Ortega Road to New Mexico State Line	342	360	18	4	15,580	This segment is rural in nature, includes seven interchanges, and is located within Apache County.

Figure 2: Study Area/Segmentation Map



2 CANDIDATE SOLUTION EVALUATION PROCESS

Candidate Solutions identified in Working Paper 5 will be evaluated in multiple ways including a Life Cycle Cost (where applicable), Risk Analysis, and a Performance Effectiveness Analysis. The methodology and approach to this analysis is described below. **Figure 3** illustrates the candidate solution evaluation process.

2.1 Life Cycle Cost Analysis

All pavement and bridge candidate solutions have multiple options: rehabilitate the area of need, or fully reconstruct the issue area or structure. These options will be evaluated through a life-cycle cost analysis (LCCA) to determine the best approach for each location where a pavement or bridge solution is recommended. The LCCA could eliminate options from further consideration and will identify which options should be carried forward for further evaluation. After the LCCA and BCA, the remaining options will be advanced to the Performance Effectiveness Evaluation.

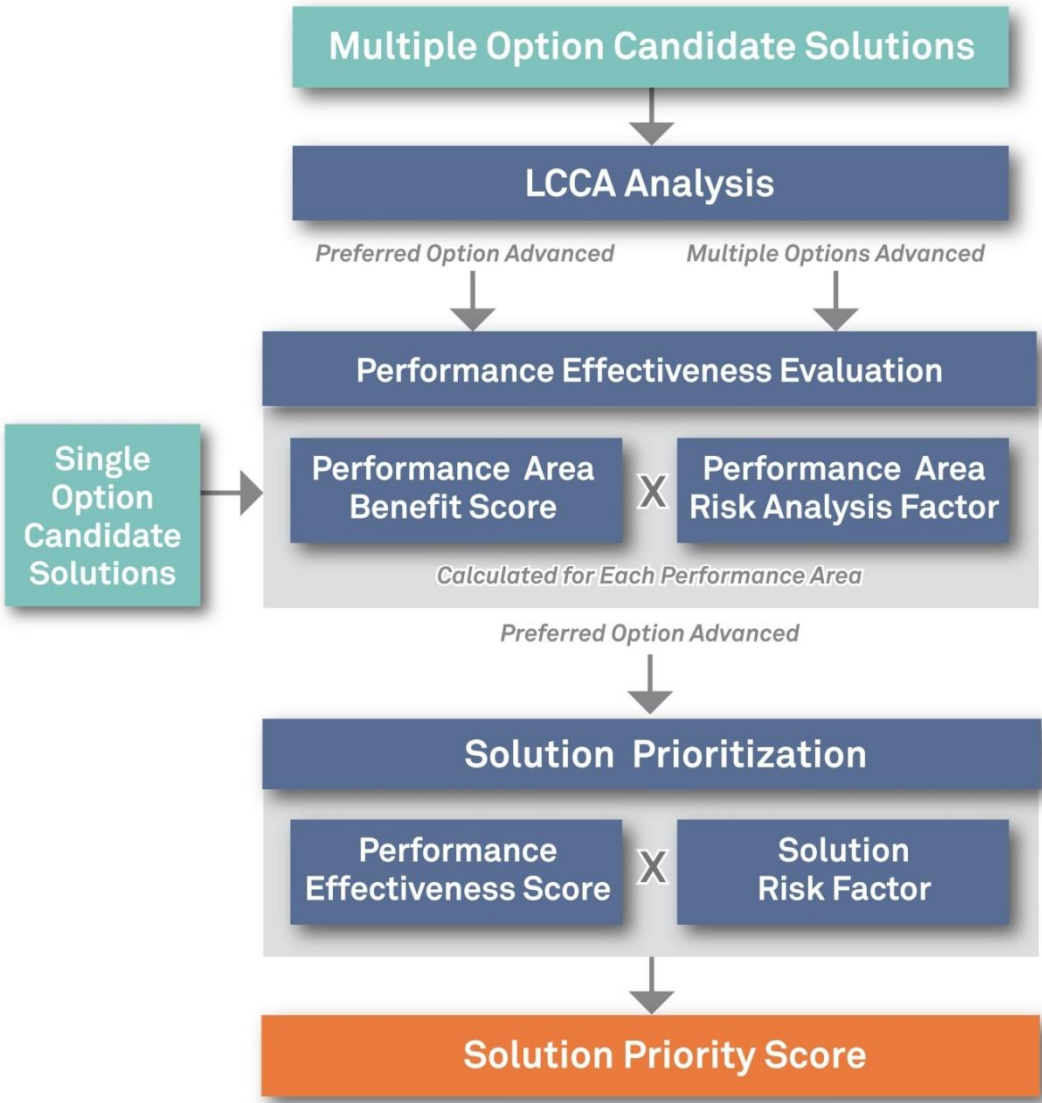
2.2 Performance Effectiveness Evaluation

After the LCCA process is complete, all remaining candidate solutions will be evaluated based on their performance effectiveness. This process will include determining a Performance Effectiveness Score (PES) based on how much each solution impacts the existing Performance and Needs scores for each project segment. This process is modeled after a benefit/cost analysis, with the benefits measured in the performance system. This evaluation will also include a Performance Area Risk Evaluation to help differentiate between similar solutions based on factors that are not directly addressed in the performance system.

2.3 Risk Analysis

All candidate solutions that are advanced through the Performance Effectiveness Evaluation will also be evaluated through a Risk Analysis process. This process will examine the risk of not implementing a recommended solution in terms of overall corridor performance. The results of this analysis will be combined with the Performance Effectiveness scores to determine the highest priority solutions in the corridor.

Figure 3: Solution Evaluation Process



3 CANDIDATE SOLUTION EVALUATION

The principal objective of the corridor profile study is to identify strategic solutions (investments) that are performance-based to ensure that available funding resources are used to maximize the performance of the State’s key transportation corridors. The corridor profile process is intended to provide input to the P2P process and will assign strategic solutions to one of the three investment categories: Preservation, Modernization, or Expansion.

The performance system and performance needs previously documented in Working Papers 2 and 4, respectively, served as a foundation for developing strategic solutions for corridor preservation, modernization, and expansion.

Strategic solutions are not intended to recreate or replace results from normal programming processes. However, they should address elevated levels (high or medium) of need and focus on investments in Modernization projects to optimize current infrastructure. Ideally, strategic solutions should address overlapping needs and reduce costly repetitive maintenance. In addition, they should provide a measureable benefit (risk, LCCA, performance system, etc.)

Strategic solutions were derived from previous reports, field reviews, ADOT staff input, observable trends in the performance data, current standards, national and local best practices, and engineering judgement, as documented in Draft Working Paper 5. **Table 2** contains the candidate

strategic solutions for the corridor. Cost estimates for each candidate solution are contained in **Appendix A**.

Following the distribution of Working Paper 5 (Strategic Solutions), candidate solutions were reviewed based on location, solution characteristics, and length. The following considerations were also made:

- Solutions that affect a specific subset of crashes (e.g., lighting, wildlife crossing or fencing) should be separated from other solutions and considered by themselves.
- Solutions that have an elevated crash modification factor (e.g. < 0.50) should be separated from other solutions and considered by themselves (e.g. mainline realignment, parallel entry/exit ramps).
- Solutions should be packaged together by location/geography to the extent possible.

This analysis may have resulted in the combination or modification of the solutions presented in Working Paper 5.

Table 2: Candidate Solutions

Solution #	BMP	EMP	Name	Option*	Scope	Investment Category (P/M/E)
CS40.01	196 EB	196 WB	Lone Tree Road OP EB Bridge	A	Rehabilitate/repair Lone Tre Rd OP EB bridge	P
				B	Replace Lone Tre Rd OP EB bridge	M
CS40.02	196 WB	196 WB	Lone Tree Road OP WB Bridge	A	Rehabilitate/repair Lone Tre Rd OP WB bridge	P
				B	Replace Lone Tre Rd OP WB bridge	M
CS40.03	196	200	Flagstaff Safety Improvements	-	Enhance delineation (striping, delineators, rumble strips) Install safety edge Rehabilitate/widen inside shoulder Implement variable speed limits (wireless, ground-mount) Install in-lane route pavement markings for WB I-40 at I-17/I-40 Install Roadside Weather Information System (RWIS) Install Closed Circuit Television (CCTV) Camera near existing DMS located at MP 199.6 EB Install rock-fall mitigation near MP 199	M
CS40.04	196	202	Flagstaff Lighting	-	Install lighting	M
CS40.05	198	200	Flagstaff Pedestrian Improvements	-	Install access barrier fence Install grade separated pedestrian crossing	M
CS40.06	198.5	199.5	Butler TI	-	Construct/extend parallel entrance/exit ramps at Butler TI (MP 199)	M
CS40.07	200	207	East Flagstaff Safety Improvements	-	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace) MP 200-202 Install chevrons and curve warning signs MP 200-202 Enhance delineation (striping, delineators, rumble strips) Install safety edge Implement variable speed limits (wireless, ground-mount) Rehabilitate/widen inside shoulder	M
CS40.08	204.5	207.5	Walnut Canyon & Cosnino TI Lighting	-	Install lighting (solar powered LED) at Walnut Canyon TI (MP 205) and Cosnino TI (MP 207)	M
CS40.09	207	212	Winona Safety Improvements	-	Improve skid resistance (reconstruct pavement, increase super-election, or mill and replace) MP 207-208 and MP 210-212 Install chevrons and curve warning signs MP 207-208 and MP 210-212 Enhance delineation (striping, delineators, rumble strips) Install safety edge Rehabilitate/widen inside shoulder Implement variable speed limits (wireless, ground-mount) Install Roadside Weather Information System (RWIS) Install new EB DMS near MP 212.1 with CCTV	M
CS40.10	201.5	205.5	Country Club and Walnut Canyon	-	Construct/extend parallel entrance/exit ramps at Country Club TI (MP 202) and Walnut Canyon TI (MP 205)	M
CS40.11	203 EB	204 EB	West of Walnut Canyon Rd Pavement	A	Rehabilitate/repair pavement	P
				B	Replace pavement	M

* '-': Indicates only one solution is being proposed and no options are being considered

Solution #	BMP	EMP	Name	Option*	Scope	Investment Category (P/M/E)
CS40.12	218	220	Canyon Diablo West Safety Improvements	-	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace) Install chevrons and curve warning signs Install dynamic speed feedback system near WB MP 220 and EB MP 218 Install safety edge Enhance delineation (striping, delineators, rumble strips) Rehabilitate/widen inside shoulder	M
CS40.13	220	229	Canyon Diablo Safety Improvements	-	Install safety edge Enhance delineation (striping, delineators, rumble strips) Rehabilitate/widen inside shoulder Install Roadside Weather Information System (RWIS) near MP 222-223 Install dynamic wind warning system near MP 222-223	M
CS40.14	219.5	220.5	Twin Arrows TI	-	Construct/extend parallel entrance/exit ramps at Twin Arrows TI (MP 220)	M
CS40.15	229	230	Canyon Diablo East Safety Improvements	-	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace) Install chevrons and curve warning signs Install dynamic speed feedback system near WB MP 230 and EB MP 229 Install safety edge Enhance delineation (striping, delineators, rumble strips) Rehabilitate/widen inside shoulder Retrofit Roadside Weather Information System (RWIS) at MP 230 (Two Guns)	M
CS40.16	225 WB	225 WB	Buffalo Range TI OP WB Bridge	A	Rehabilitate/repair Buffalo Range TI OP WB bridge	P
				B	Replace Buffalo Range TI OP WB bridge	M
CS40.17	258	266	East Winslow Safety Improvements	-	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace) MP 258-260 Install dynamic speed feedback system near WB MP 260 and EB MP 258 Install safety edge Enhance delineation (striping, delineators, rumble strips) Install Closed Circuit Television (CCTV) Cameral near existing DMS located at MP 260.2 WB	M
CS40.18	274 WB	275 WB	Joseph City Pavement	A	Rehabilitate/repair pavement	P
				B	Replace pavement	M
CS40.19	284 EB	284 EB	Leroux Wash BR EB Bridge	A	Rehabilitate/repair Leroux Wash BR EB bridge	P
				B	Replace Leroux Wash BR EB bridge	M
CS40.20	284 WB	284 WB	Leroux Wash BR WB Bridge	A	Rehabilitate/repair Leroux Wash BR WB bridge	P
				B	Replace Leroux Wash BR WB bridge	M
CS40.21	290 WB	290 WB	E Holbrook TI OP WB Bridge	A	Rehabilitate/repair E Holbrook TI OP WB bridge	P
				B	Replace E Holbrook TI OP WB bridge	M
CS40.22	290 EB	290 EB	E Holbrook TI OP EB Bridge	A	Rehabilitate/repair E Holbrook TI OP EB bridge	P

* '-': Indicates only one solution is being proposed and no options are being considered

Solution #	BMP	EMP	Name	Option*	Scope	Investment Category (P/M/E)
				B	Replace E Holbrook TI OP EB bridge	M
CS40.23	311.5	311.5	Painted Desert TI UP Bridge	A	Rehabilitate/repair Painted Desert TI UP bridge	P
				B	Replace Painted Desert TI UP bridge	M
CS40.24	345	351	Lupton West Safety Improvement	-	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace) MP 345-346, 346.5-347, 349.5-350.5 Install dynamic speed feedback system MP 345 EB and MP 351 WB Install chevrons and curve warning signs MP 345-346, 346.5-347, 349.5-350.5 Enhance delineation (striping, delineators, rumble strips) Install safety edge Install dynamic wind warning system near MP 349- 350 Install Roadside Weather Information System (RWIS) near MP 349-350	M
CS40.25	351	360	Lupton East Safety Improvement	-	Enhance delineation (striping, delineators, rumble strips) Install safety edge	M
CS40.26	347.5	359.5	Lupton TI Improvements	-	Construct/extend parallel entrance/exit ramps at Houck TI (MP 348), Lupton TI (MP 359), and WB rest area (MP 359)	M
CS40.27	358 WB	358 WB	Window Rock TI OP WB Bridge	A	Rehabilitate/repair Window Rock TI OP WB bridge	P
				B	Replace Window Rock TI OP WB bridge	M

* '-': Indicates only one solution is being proposed and no options are being considered

3.1 Life-Cycle Cost Analysis

A LCCA was conducted for any bridge or pavement candidate solutions that contain multiple options. The intent of the LCCA was to determine which options warrant further investigation and eliminate options that would not be considered strategic. All dollar amounts are in 2015 dollars.

Life-Cycle Cost Analysis is an economic analysis that compares cost streams over time and presents the results in a common measure, the present value of all future costs. The cost stream occurs over an analysis period that is long enough to provide a reasonably fair comparison among alternatives that may differ significantly in scale of improvement actions over shorter time periods. For both bridge and pavement LCCA, the costs are focused on agency (ADOT) costs for corrective actions to meet the objective of keeping the bridge or pavement serviceable over a long period of time. User costs were not directly considered.

LCCA is performed to provide a more complete holistic perspective on asset performance and agency costs over the life of an investment stream. This approach helps ADOT look beyond initial and short term costs which often dominate the considerations in transportation investment decision making and programming.

Bridge

For the bridge LCCA, three basic strategies were analyzed that differ in timing and scale of improvement actions to maintain the selected bridges, as described below:

- Bridge replacement (large upfront cost but small ongoing costs afterwards).
- Bridge rehabilitation until replacement (moderate upfront costs then small to moderate ongoing costs until replacement).
- On-going repairs until replacement (low upfront and more frequent ongoing costs until replacement).

The bridge LCCA model developed for the Corridor Profile Studies reviews the characteristics of the candidate bridges including bridge ratings and deterioration rates to develop the three improvement strategies (full replacement, rehabilitation until replacement, and repair until replacement). Each strategy consists of a set of corrective actions that contribute to keeping the bridge serviceable over the analysis period. Cost and effect of these improvement actions on the bridge condition are essential parts of the model. Other considerations in the model include bridge age, elevation, pier height, length to span ratio, skew angle, and substandard characteristics such as shoulders and vehicle clearance. The following assumptions are included in the bridge LCCA model:

- The bridge LCCA only addresses the structural condition of the bridge and does not address other issues or costs.
- The bridge will require replacement near the end of its 75 year service life regardless of current condition.
- The bridge elevation, pier height, skew angle, and length to span ratio can affect the replacement and rehabilitation costs.

- The current and historical ratings were used to estimate a rate of deterioration for each candidate bridge.
- Following bridge replacement, repairs will be needed every 20 years.
- Different bridge repair and rehabilitation strategies have different costs, expected service life, and benefit to the bridge rating.
- The present value of future costs was calculated at a 3% discount rate.
- If the LCCA evaluation recommends rehabilitation or repair, the project was not considered strategic and the rehabilitation or repair will be addressed by normal programming processes.
- Because this LCCA is conducted at a planning level, and due to the variabilities in costs and improvement strategies, the LCCA net present value results that are within 10% - 15% should be considered equally. In such a case, the project should be carried forward as a strategic replacement project – more detailed scoping will confirm if replacement or rehabilitation is needed.

Based on the candidate solutions presented in **Table 2**, LCCA was conducted on nine bridges on the I-40 East corridor. A summary of this analysis is shown in **Table 3**. Additional information regarding the LCCA is contained in **Appendix B**.

Pavement

The LCCA approach to pavement was very similar to the process used for bridges. For the pavement LCCA, three basic strategies were analyzed that differ in timing and scale of improvement actions to maintain the selected pavement, as described below:

- Pavement replacement (large upfront cost but small ongoing costs afterwards—could be replacement with asphalt or concrete pavement)
- Pavement major rehabilitation until replacement (moderate upfront costs then small to moderate ongoing costs until replacement)
- Pavement minor rehabilitation until replacement (low upfront and ongoing costs until replacement)

The pavement LCCA model developed for the Corridor Profile Studies reviewed the characteristics of the candidate paving locations including the historical rehabilitation frequency to develop potential improvement strategies (full replacement, major rehabilitation until replacement, minor rehabilitation until replacement, for either concrete or asphalt, as applicable). Each strategy consists of a set of corrective actions that contribute to keeping the pavement serviceable over the analysis period. The following assumptions are included in the pavement LCCA model:

- The pavement LCCA will only address the condition of the pavement and will not address other issues or costs.
- The historical pavement rehabilitation frequencies at each location were used to estimate the future rehabilitation frequencies.

- Different pavement replacement and rehabilitation strategies have different costs and expected service life.
- The net present value of future costs will be discounted at 3%.
- If the LCCA evaluation recommends rehabilitation, the project will not be considered strategic and the rehabilitation will be addressed by normal programming processes.
- Because this LCCA is conducted at a planning level, and due to variabilities in costs and improvement strategies, the LCCA net present value results that are within 10%-15% should be considered equally. In such a case, the project should be carried forward as a strategic replacement project – more detailed scoping will confirm if replacement or rehabilitation is needed.

Based on the candidate solutions presented in **Table 2**, LCCA was conducted for two pavement solutions on the I-40 East corridor. A summary of this analysis is shown in **Table 4**. Additional information regarding the LCCA is contained in **Appendix B**.

As shown in Tables 3 and 4, the following conclusions were determined based on the LCCA:

- Rehabilitation or repair was determined to be the most effective approach for the candidate solutions listed below and these locations do not have other Needs that relate directly to the bridge. Therefore, it is assumed that the identified needs will be addressed by normal programming processes and these candidate solutions will be dropped from further consideration.
 - Lone Tree Road OP EB Bridge (CS40.01)(MP EB 196)
 - Lone Tree Road OP WB Bridge (CS40.02)(MP WB 196)
 - Buffalo Range TI OP WB Bridge (CS40.16) (MP WB 225)
 - Leroux Wash BR EB Bridge (CS40.19)(MP EB 284)
 - Leroux Wash BR WB Bridge (CS40.20)(MP WB 284)
 - E Holbrook TI OP WB Bridge (CS40.21)(MP WB 290)
 - E Holbrook TI OP EB Bridge (CS40.22)(MP EB 290)
 - Painted Desert TI UP Bridge (CS40.23)(MP 311.5)
 - Window Rock TI OP WB Bridge (CS40.27) (MP WB 358)
 - Joseph City Pavement (CS 40.18)(MP WB 274-275)

Table 3: Bridge LCCA Results

Candidate Solution	Present Value at 3% Discount Rate (\$)			Ratio of Present Value Compared to Lowest Present Value			Other Needs	Results
	Replace	Rehab	Repair	Replace	Rehab	Repair		
Lone Tree Road OP EB Bridge (CS40.01)	\$1,809,000	\$1,542,000	\$1,191,000	1.52	1.29	1.00	Yes	Not strategic as a stand-alone solution and other needs are not related to bridge; no further evaluation
Lone Tree Road OP WB Bridge (CS40.02)	\$1,809,000	\$1,549,000	\$1,201,000	1.51	1.29	1.00	Yes	Not strategic as a stand-alone solution and other needs are not related to bridge; no further evaluation
Buffalo Range TI OP WB Bridge (CS40.16)	\$1,769,000	\$1,420,000	\$1,160,000	1.52	1.22	1.00	Yes	Not strategic as a stand-alone solution and other needs are not related to bridge; no further evaluation
Leroux Wash BR EB Bridge (CS40.19)	\$7,068,000	\$6,359,000	\$4,006,000	1.76	1.59	1.00	No	Not strategic as a stand-alone solution and no other Needs—no further evaluation
Leroux Wash BR WB Bridge (CS40.20)	\$7,068,000	\$6,419,000	\$5,911,000	1.20	1.09	1.00	No	Not strategic as a stand-alone solution and no other Needs—no further evaluation
E Holbrook TI OP WB Bridge (CS40.21)	\$4,353,000	\$3,328,000	\$2,582,000	1.69	1.29	1.00	No	Not strategic as a stand-alone solution and no other Needs—no further evaluation
E Holbrook TI OP EB Bridge (CS40.22)	\$4,353,000	\$3,461,000	\$2,856,000	1.52	1.21	1.00	No	Not strategic as a stand-alone solution and no other Needs—no further evaluation
Painted Desert TI UP Bridge (CS40.23)	\$3,544,000	\$2,967,000	\$2,615,000	1.36	1.13	1.00	No	Not strategic as a stand-alone solution and no other Needs—no further evaluation
Window Rock TI OP WB Bridge (CS40.27)	\$572,000	\$516,000	\$418,000	1.37	1.23	1.00	Yes	Not strategic as a stand-alone solution and other needs are not related to bridge; no further evaluation

Table 4: Pavement LCCA Results

Candidate Solution	Present Value at 3% Discount Rate (\$)				Ratio of Present Value Compared to Lowest Present Value				Other Needs	Results
	Concrete Reconstruction	Asphalt Reconstruction	Asphalt Medium Rehabilitation	Asphalt Light Rehabilitation	Concrete Reconstruction	Asphalt Reconstruction	Asphalt Medium Rehabilitation	Asphalt Light Rehabilitation		
West of Walnut Canyon Rd (CS40.11)(MP EB 203-204)	\$4,523,000	\$4,739,000	\$4,023,000	\$4,556,000	1.12	1.18	1.00	1.13	Yes	Strategic as a stand-alone solution; recommend further evaluation
Joseph City (CS40.18)(MP WB 274-275)	\$4,523,000	\$4,739,000	\$3,810,000	\$4,202,000	1.19	1.24	1.00	1.10	No	Not strategic as a stand-alone solution and no other needs present – no further evaluation

3.2 Performance Effectiveness Evaluation

The results of the performance Effectiveness Evaluation will be combined with the results of a risk analysis to determine a Performance Effectiveness Score. The objectives of the Performance Effectiveness Evaluation include:

- Measure of benefit in performance system versus cost of solution
- Include risk factors to help differentiate between similar solutions
- Applicable to each Performance Area that is affected by the candidate solution
- Accounts for Emphasis Areas that were identified for the corridor

The Performance Effectiveness Evaluation includes the following steps:

- Estimate the post-project performance for each of the five performance areas (Bridge, Pavement, Safety, Mobility, and Freight)
- Use the post-solution performance scores to calculate a post-solution level of Need for each of the five performance areas
- Compare the pre-solution level of Need to the post-solution level of Need to determine the reduction in level of Need (potential project benefit) for each of the five performance areas
- Calculate performance area risk weighting factors for each of the five performance areas
- Using the reduction in level of Need (benefit) and risk weighting factors, calculate the Performance Effectiveness Score

For each Performance Area, a slightly different approach was used to estimate the post-project performance. This process was based on the following assumptions:

- Pavement:
 - The IRI rating would decrease (to 30 for replacement or 45 for rehabilitation)
 - The Cracking rating would decrease (to 0 for replacement or rehabilitation)
- Bridge:
 - The structural ratings would increase (+1 for repair, +2 for rehabilitation, or increase to 8 for replacement)
 - The bridge sufficiency rating would increase (+10 for repair, +20 for rehabilitation, or increase to 98 for replacement)
- Mobility:
 - Additional lanes would increase the capacity and therefore revise the Mobility Index and two secondary measures
 - Other improvements (ramp metering, parallel ramps, variable speed limits) will also increase the capacity (to a lesser extent than additional lanes) and therefore revise the Mobility Index and two secondary measures
 - Changes in the Mobility Index (due to increased capacity) would have a direct effect on the TTI secondary measure

- Changes in the Mobility Index (due to increased capacity) and Safety Index (due to crash reductions) would have a direct effect on the PTI secondary measure
- Changes in the Safety Index (due to crash reductions) would have direct effect on the Closure Extent secondary measure
- Safety:
 - Crash Modification Factors were developed and applied to estimate the reduction in crashes (for additional information see **Appendix C**)
- Freight:
 - Changes in the Mobility Index (due to increased capacity) and Safety Index (due to crash reductions) would have a direct effect on the Freight Index and the TPTI secondary measure
 - Changes in the Mobility Index (due to increased capacity) would have a direct effect on the TTTI secondary measure
 - Changes in the Safety Index (due to crash reductions) would have direct effect on the Closure Duration secondary measure

The Performance Area Risk Assessment is intended to develop a numeric risk weighting factor for each of the five Performance Areas (Bridge, Pavement, Safety, Mobility, and Freight). This risk assessment addresses other considerations for each Performance Area that are not directly included in the Performance System. A risk weighting factor is calculated for each candidate solution based on the specific characteristics at the project location. For example, the Pavement Risk Factor is based on factors such as the elevation, daily traffic volumes, and amount of truck traffic. Additional information regarding the Performance Area Risk Factors is included in **Appendix D**.

Following the calculation of the reduction in level of Need (benefit) and the Performance Area Risk Factors, these values were used to calculate the Performance Effectiveness Score. In addition, the reduction in level of Need in each Emphasis Area was also included in the Performance Effectiveness Score.

The benefit (reduction in Need) is measured as a one-time benefit. However, different types of solutions will have varying service lives during which the benefits will be obtained. For example, a preservation solution would likely have a shorter stream of benefits over time when compared to a modernization or expansion solution. To address the varying lengths of benefit streams, each solution was classified as a 10-year, 20-year, 30-year, or 75-year benefit stream (the F_{NPV} factor). A 3% discount rate was used to calculate F_{NPV} for each classification of solution. The service lives and respective factors are described below:

- A 10-year service life is generally reflective of a preservation solution. This would include pavement and bridge preservation solutions which would likely have a 10 year stream of benefits. For these solutions, a F_{NPV} of 8.8 was used in the PES calculation (based on a 3% discount rate).

- A 20-year service life is reflective of modernization solutions that generally do not include new infrastructure. These solutions would likely have a 20 year stream of benefits. For these solutions, a F_{NPV} of 15.3 was used in the PES calculation (based on a 3% discount rate).
- A 30-year service life is generally reflective of an expansion solution or a modernization solution that includes new infrastructure. These solutions would likely have a 30 year stream of benefits. For these solutions, a F_{NPV} of 20.2 was used in the PES calculation (based on a 3% discount rate).
- A 75-year service life was used for bridge replacement solutions. For these solutions, a F_{NPV} of 30.6 was used in the PES calculation (based on a 3% discount rate).

Each solution also has varying degrees of exposure depending on the length of the solution and the daily traffic volume. The vehicle-miles travelled (VMT) at each solution provides a measure of the amount of traffic that would receive the benefit of the proposed solution. The following equation was used to calculate a factor (between 0 and 5) which was used in the calculation of the Performance Effectiveness Score.

$$F_{VMT} = 5 - (5 \times e^{VMT \times -0.0000139})$$

The performance Effectiveness Score (PES) can be described as follows:

$$PES = (\text{Sum of all Risk Factored Benefit Scores} + \text{Sum of all Risk Factored Emphasis Area Scores}) / \text{Cost} \times F_{VMT} \times F_{NPV}$$

Where,

Risk Factored Benefit Score = Reduction in Segment-Level Need (benefit) x Performance Area Risk Weighting Factor (calculated for each Performance Area)

Risk Factored Emphasis Area Score = Reduction in Corridor-Level Need x Performance Area Risk Factors x Emphasis Area Factor (calculated for each Emphasis Area)

*Cost = estimate cost of candidate solution in \$millions (see **Appendix A**)*

F_{VMT} = Factor between 0 and 5 to account for vehicle miles travelled at location of candidate solution based on current (2014) daily volume and length of solution

F_{NPV} = Factor (ranging from 8.8 to 30.6, see above) to address anticipated longevity of service life (and duration of benefits) for each candidate solution

The resulting PES values are shown in **Table 5**. Additional information regarding the calculation of the PES is contained in **Appendix E**.

Table 5: Initial Performance Effectiveness Scores

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost* (\$ million)	Risk Factored Benefit Score					Risk Factored Emphasis Area Scores			Total Factored Benefit Score	F _{VMT}	F _{NPV}	Performance Effectiveness Score
				Pavement	Bridge	Safety	Mobility	Freight	Safety	Pavement	Bridge				
40.03	Flagstaff Safety Improvements	196 – 200	\$10.20	0.00	0.00	5.35	0.35	0.26	0.04	0.00	0.00	5.99	4.38	15.3	39.4
40.04	Flagstaff Lighting	196 – 202	\$8.06	0.00	0.00	3.75	0.12	0.18	0.02	0.00	0.00	4.07	4.78	15.3	37.0
40.05	Flagstaff Pedestrian Improvements	198 - 200	\$2.82	0.00	0.00	11.27	0.32	0.49	0.07	0.00	0.00	12.08	0.61	20.2	53.4
40.06	Butler TI	198.5 – 199.5	\$4.43	0.00	0.00	6.04	0.09	0.22	0.03	0.00	0.00	6.38	1.15	20.2	33.5
40.07	East Flagstaff Safety Improvements	200 - 207	\$23.59	0.00	0.00	5.07	0.23	0.45	0.05	0.00	0.00	5.79	3.44	15.3	12.9
40.08	Walnut Canyon & Cosnino TI Lighting	204.5 – 207.5	\$0.99	0.00	0.00	1.82	0.12	0.17	0.03	0.00	0.00	2.14	1.16	15.3	38.5
40.09	Winona Safety Improvements	207 - 212	\$22.21	0.00	0.00	3.86	0.61	0.59	0.06	0.00	0.00	5.11	3.67	15.3	12.9
40.10	Country Club and Walnut Canyon	201.5 – 205.5	\$8.85	0.00	0.00	2.13	0.15	0.31	0.03	0.00	0.00	2.63	1.16	20.2	7.0
40.11	West of Walnut Canyon Pavement	202 – 205 EB	\$12.92	1.19	0.00	0.10	0.01	0.01	0.00	0.06	0.00	1.36	1.65	15.3	2.7
40.12	Canyon Diablo West Safety Improvements	218 – 220	\$10.05	0.00	0.00	1.26	0.17	0.23	0.04	0.00	0.00	1.70	1.81	15.3	4.7
40.13	Canyon Diablo Safety Improvements	220 – 229	\$13.95	0.00	0.00	0.91	0.15	0.16	0.03	0.00	0.00	1.25	4.34	15.3	6.0
40.14	Twin Arrows TI	219.5 – 220.5	\$4.43	0.00	0.00	1.33	0.17	0.24	0.04	0.00	0.00	1.77	1.01	20.2	8.1
40.15	Canyon Diablo East Safety Improvements	229 - 230	\$5.09	0.00	0.00	0.41	0.04	0.08	0.01	0.00	0.00	0.54	1.01	15.3	1.6
40.17	East Winslow Safety Improvements	258 - 266	\$10.86	0.00	0.00	1.89	0.06	0.01	0.03	0.00	0.00	2.00	4.17	15.3	11.7
40.24	Lupton West Safety Improvement	345 -351	\$11.86	0.00	0.00	1.78	0.01	0.02	0.03	0.00	0.00	1.85	3.68	15.3	8.8
40.25	Lupton East Safety Improvements	351 - 359	\$4.60	0.00	0.00	0.79	0.03	0.01	0.02	0.00	0.00	0.85	4.33	15.3	12.2
40.26	Lupton Area TI Improvements	347.5 – 359.5	\$9.96	0.00	0.00	1.21	0.02	0.01	0.03	0.00	0.00	1.27	1.21	20.2	3.1

*: See Table 6 for total construction costs

4 CANDIDATE SOLUTION PRIORTIZATION

Following the calculation of the Performance Effectiveness Scores (PES), an additional step was taken to develop the prioritized list of solutions. A risk probability and consequence analysis was conducted to develop a project-level risk weighting factor. This risk analysis is a numeric scoring system to help address the risk of not implementing a solution based on the likelihood and severity of the performance failure. **Figure 4** shows the risk matrix that was used to develop the risk weighting factors.

Figure 4: Risk Matrix

		Severity/Consequence				
		Insignificant	Minor	Significant	Major	Catastrophic
Frequency/Likelihood	Very Rare	Low	Low	Low	Moderate	Major
	Rare	Low	Low	Moderate	Major	Major
	Seldom	Low	Moderate	Moderate	Major	Severe
	Common	Moderate	Moderate	Major	Severe	Severe
	Frequent	Moderate	Major	Severe	Severe	Severe

Using the risk matrix in **Figure 4**, numeric values were assigned to each category of frequency and severity. The higher the risk, the higher the numeric factor that was assigned. The risk weight for each area of the matrix was calculated by multiplying the severity factor times the frequency factor. These numeric factors are shown in **Figure 5**.

Figure 5: Numeric Risk Matrix

			Severity/Consequence				
			Insignificant	Minor	Significant	Major	Catastrophic
		Weight	1.00	1.10	1.20	1.30	1.40
Frequency/Likelihood	Very Rare	1.00	1.00	1.10	1.20	1.30	1.40
	Rare	1.10	1.10	1.21	1.32	1.43	1.54
	Seldom	1.20	1.20	1.32	1.44	1.56	1.68
	Common	1.30	1.30	1.43	1.56	1.69	1.82
	Frequent	1.40	1.40	1.54	1.68	1.82	1.96

Using the values in **Figure 5**, risk weighting factors were calculated for each of the four risk categories (low, moderate, major, and severe). These values are simply the average of the values in Figure 5 that fall within each category. The resulting average risk weighting factors are:

Low	Moderate	Major	Severe
1.14	1.36	1.51	1.78

The risk weighting factors listed above were assigned to the five performance areas as follows:

- Safety = 1.78
 - The Safety performance area quantifies the likelihood of fatal or incapacitating crashes; therefore, it was assigned the highest (Severe) risk weight.
- Bridge = 1.51
 - The Bridge performance area focuses on the structural adequacy of the bridges. A failure may result in crashes (that would not be addressed in the Safety performance area) or traffic being detoured for long periods of time resulting in significant travel time increases; therefore, it was assigned the Major (1.24) risk weighting factor.
- Mobility and Freight = 1.36
 - The Mobility and Freight performance areas focus on capacity and congestion. Failure in either of these performance areas would result in increased travel times but would not have significant effect on safety (crashes) that would not already be addressed in the Safety performance area; therefore, they were assigned the Moderate (1.18) risk weighing factor.
- Pavement = 1.14
 - The Pavement performance area focuses on the ride quality of the pavement. Failure in this performance area would likely be a spot location that would not dramatically affect drivers beyond what is already captured in the Safety performance area.

The benefit in each performance area was calculated for each candidate solution as part of the Performance Effectiveness Evaluation. Using this information, and the risk factors listed above, a weighted (based on benefit) solution-level numeric risk factor was calculated for each candidate solution. For example, a solution that has 50% of its benefit in Safety and 50% of its benefit in Mobility would have a risk factor of 1.27 ($0.50 \times 1.18 + 0.50 \times 1.36 = 1.27$). These risk factors were applied directly to the Performance Effectiveness Scores shown in **Table 5**. Candidate Solutions were prioritized based on these results, as shown in **Table 6**. Additional information regarding the prioritization scores is contained in **Appendix F**.

$$PS = PES \times Risk\ Factor \times Segment\ Need \text{ (see Appendix E for additional information)}$$

Where,

$$PES = Performance\ Effectiveness\ Score \text{ (Table 5)}$$

$$Risk\ Factor = Factor\ to\ address\ risk\ of\ not\ implementing\ a\ solution\ based\ on\ the\ likelihood\ and\ severity\ of\ the\ performance\ failure$$

$$Segment\ Need = Composite\ segment\ need\ score \text{ (Working Paper 4)}$$

Table 6 prioritizes the strategic solutions recommended as a result of this corridor profile study and identifies the overall percentage of need reduction as a result of each solution. These solutions were developed to increase the performance of the I-40 East corridor across all performance areas. Solutions that address multiple areas score higher in this process.

- Two safety hotspots were identified along the corridor and those corresponding solutions are ranked in the top six.

- Four solutions result in a Prioritization Score above 80 which shows that their performance benefits are much higher than their cost.
- Two of the top four solutions include the installation of lighting in locations where 60% - 70% of the fatal and serious injury crashes occur in dark conditions.
- All six of the highest ranking solutions are located where the Safety Index was the highest along the corridor.

Table 6: Prioritized Recommended Solutions List

Rank	Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost* (\$ million)	Performance Effectiveness Score	Risk Factor	Segment Need	Prioritization Score	Solution Need Reduction Notes
1	40.05	Flagstaff Pedestrian Improvements	198-200	\$2.82	53.4	1.75	1.23	115	Reduces Safety need by 77%
2	40.08	Walnut Canyon & Cosnino TI Lighting	204.5 - 207.5	\$0.99	38.5	1.72	1.46	97	Reduces Safety need by 15%
3	40.03	Flagstaff Safety Improvements	196 – 200	\$10.41	39.4	1.74	1.23	84	Reduces Safety need by 37%
4	40.04	Flagstaff Lighting	196 – 202	\$8.06	37.0	1.75	1.23	80	Reduces Safety need by 26%
5	40.06	Butler TI	198.5 - 199.5	\$4.43	33.5	1.76	1.23	73	Reduces Safety need by 42%
6	40.09	Winona Safety Improvements	207 - 212	\$22.98	12.9	1.68	1.46	32	Reduces Safety need by 38%
7	40.25	Lupton East Safety Improvements	351 - 359	\$4.60	12.2	1.76	1.46	31	Reduces Safety need by 19%
8	40.07	East Flagstaff Safety Improvements	200 - 207	\$23.59	12.9	1.72	1.39	31	Reduces Safety need by 19%
9	40.17	East Winslow Safety Improvements	258 - 266	\$10.92	11.7	1.76	1.15	24	Reduces Safety need by 63%
10	40.24	Lupton West Safety Improvements	345 -351	\$12.10	8.8	1.77	1.46	23	Reduces Safety need by 32%
11	40.14	Twin Arrows TI	219.5 – 220.5	\$4.43	8.1	1.68	1.46	20	Reduces Safety need by 25%
12	40.10	Country Club & Walnut Canyon	201.5 – 205.5	\$8.85	7.0	1.71	1.46	17	Reduces Safety need by 17%
13	40.13	Canyon Diablo Safety Improvements	220 – 229	\$14.20	6.0	1.68	1.46	15	Reduces Safety need by 17%
14	40.12	Canyon Diablo West Safety Improvements	218 – 220	\$10.05	4.7	1.68	1.46	12	Reduces Safety need by 23%
15	40.26	Lupton Area TI Improvements	347.5 - 360	\$9.96	3.1	1.77	1.46	8	Reduces Safety need by 22%
16	40.11	West of Walnut Canyon Pavement	202-205 EB	\$12.92	2.7	1.19	1.43	5	Reduces Pavement need by 32%
17	40.15	Canyon Diablo East Safety Improvements	229 - 230	\$5.24	1.6	1.68	1.46	4	Reduces Safety need by 8%

*: Cost may vary from Table 5 due to additional ITS components

5 NEXT STEPS

The strategic investments recommended in this study are not intended to be a substitute or replacement for traditional ADOT project development processes where various ADOT technical groups and districts develop candidate projects for consideration in the performance-based programming in the P2P Link process. Rather, these strategic investments are intended to complement ADOT's project development processes with non-traditional solutions to address performance needs in one or a combination of the five performance areas of Pavement, Bridge, Mobility, Safety, and Freight. Strategic investments developed for the I-40 East corridor will be considered along with other candidate projects in the ADOT statewide programming process.

The concluding step in the corridor profile studies will be to produce a final report for the Round 2 studies (I-40E, I-8, and SR95) that summarizes working papers 1 through 6. Additional final reports for rounds 3 will be completed following the full development of those working papers.

Upon completion of all three rounds, the results will be incorporated into a summary document comparing all corridors and is expected to provide a performance-based review of statewide needs.

Appendix A: Candidate Solution Cost Estimates

I-40 Corridor Solution Cost Estimates											PE	Design	ROW	Total
CS #	Project Name	Solution	BMP	EMP	Length	Sq Ft	Each	Unit	Unit Cost	Total Construction Cost	0.03	0.10	-	
40.03	Flagstaff Safety Improvements	Enhance delineation (striping, delineators, rumble strips)	196.0	200.0	8			mile	\$50,100	\$400,800	\$12,000	\$40,000	\$ -	\$452,800
		Install safety edge	196.0	200.0	8			mile	\$176,000	\$1,408,000	\$42,000	\$141,000	\$ -	\$1,591,000
		Install Roadside Weather Information System (RWIS)	196.0	202.0			1	each	\$132,000	\$132,000	\$ 4,000	\$13,000	\$ -	\$149,000
		Implement variable speed limits (wireless, ground mount)	196.0	200.0	8			mile	\$373,300	\$2,986,400	\$90,000	\$299,000	\$ -	3,375,400
		Rehabilitate/widen inside shoulder	196.0	200.0	8			mile	\$460,000	\$3,680,000	\$110,000	\$368,000	\$ -	4,158,000
		Install in-lane route pavement markings					2	each	\$13,200	\$26,400	\$1,000	\$3,000	\$ -	\$ 30,400
		Install rock fall mitigation	198.5	199.0	1			mile	\$1,045,000	\$522,500	\$16,000	\$52,000	\$ -	\$590,500
		Install CCTV Camera on existing DMS (EB)	199.6	199.6			1	each	\$55,000	\$55,000	\$2,000	\$6,000	\$ -	63,000
		TOTAL								\$9,211,100	\$277,000	\$922,000		\$10,410,100
40.04	Coconino Safety Improvements	Install lighting	196.0	202.0	12			mile	\$594,000	\$7,128,000	\$214,000	\$713,000	\$ -	8,055,000
40.05	Flagstaff Pedestrian Improvements	Install access barrier fence	198.0	200.0	21,120			LF	\$ 33	\$696,960	\$21,000	\$70,000	\$ -	\$787,960
		Ped crossing/bridge			600	6,000		SF	\$300	\$1,800,000	\$ 54,000	\$180,000	\$ -	\$ 2,034,000
		TOTAL								\$2,496,960	\$75,000	\$ 250,000		\$ 2,821,960
40.06	Butler TI	Construct/extend parallel entrance/exit ramps @ Butler TI	199.0	199.0			4	each	\$979,000	\$3,916,000	\$117,000	\$ 392,000	\$ -	\$ 4,425,000
40.07	East Flagstaff Safety Improvements	Implement variable speed limits (wireless, ground mount)	200	207	14				\$ 373,300	\$ 5,226,200	\$ 157,000	\$ 523,000	\$ -	\$ 5,906,200
		Install Safety Edge	200	207	14				\$ 176,000	\$ 2,464,000	\$ 74,000	\$ 246,000	\$ -	\$ 2,784,000
		Enhance delineation (striping, delineators, rumble strips)	200	207	14				\$ 50,100	\$ 701,400	\$21,000	\$ 70,000	\$ -	\$ 792,400
		Rehabilitate/widen inside shoulder	200	207	14				\$ 460,000	\$ 6,440,000	\$ 193,000	\$ 644,000	\$ -	\$ 7,277,000
		Install chevrons and curve warning signs	200.0	202.0	4			mile	\$ 40,500	\$ 162,000	\$ 5,000	\$ 16,000	\$ -	\$ 183,000
		Improve skid resistance (reconstruct pavement, increase superelevation, or mill and replace)	200.0	202.0	4			mile	\$1,470,000	\$ 5,880,000	\$176,000	\$ 588,000	\$ -	\$ 6,644,000
		TOTAL								\$20,873,600	\$ 626,000	\$ 2,087,000	\$ -	\$ 23,586,600
40.08	Walnut Canyon & Cosnino TI Lighting	Install lighting (solar powered LED) at Walnut Canyon TI	205.0	205.0			20	each	\$ 22,000	\$ 440,000	\$13,000	\$ 44,000	\$ -	\$ 497,000
		Install lighting (solar powered LED) at Cosnino TI	207.0	207.0			20	each	\$ 22,000	\$ 440,000	\$ 13,000	\$ 44,000	\$ -	\$ 497,000
		TOTAL								\$ 880,000	\$ 26,000	\$ 88,000	\$ -	\$ 994,000
40.09	Winona Safety Improvements	Improve skid resistance (reconstruct pavement, increase superelevation, or mill and replace)	207.0	208.0	2			mile	\$1,470,000	\$2,940,000	\$ 88,000	\$ 294,000	\$ -	\$ 3,322,000
		Improve skid resistance (reconstruct pavement, increase superelevation, or mill and replace)	210.0	212.0	4			mile	\$1,470,000	\$ 5,880,000	\$176,000	\$ 588,000	\$ -	\$ 6,644,000
		Install Safety Edge	207.0	212.0	10			mile	\$ 176,000	\$ 1,760,000	\$ 53,000	\$ 176,000		\$ 1,989,000
		Rehabilitate/widen inside shoulder	207.0	212.0	10			mile	\$ 460,000	\$ 4,600,000	\$ 138,000	\$ 460,000		\$ 5,198,000
		Enhance delineation (striping, delineators, rumble strips)	207.0	212.0	10			mile	\$ 50,100	\$ 501,000	\$ 15,000	\$ 50,000		\$ 566,000
		Implement variable speed limits (wireless, ground mount)	207.0	212.0	10			mile	\$ 373,300	\$ 3,733,000	\$ 112,000	\$ 373,000		\$ 4,218,000
		Install chevrons and curve warning signs	207.0	208.0	2			mile	\$ 40,500	\$ 81,000	\$ 2,000	\$ 8,000	\$ -	\$ 91,000

I-40 Corridor Solution Cost Estimates											PE	Design	ROW	Total
CS #	Project Name	Solution	BMP	EMP	Length	Sq Ft	Each	Unit	Unit Cost	Total Construction Cost	0.03	0.10	-	
		Install chevrons and curve warning signs	210.0	212.0	4			mile	\$ 40,500	\$ 162,000	\$ 5,000	\$ 16,000	\$ -	\$ 183,000
		Install Roadside Weather Information System (RWIS)					1	each	\$ 132,000	\$ 132,000	\$ 4,000	\$ 13,000		\$ 149,000
		Install new EB DMS with CCTV	212.1	212.1			1	each	\$ 550,000	\$ 550,000	\$ 17,000	\$ 55,000		\$ 622,000
		TOTAL								\$20,339,000	\$ 610,000	\$ 2,033,000	\$ -	\$ 22,982,000
40.10	Country Club & Walnut Canyon	Construct/extend parallel entrance/exit ramps at Country Club TI	202.0	202.0			4	each	\$ 979,000	\$ 3,916,000	\$ 117,000	\$ 392,000	\$ -	\$ 4,425,000
		Construct/extend parallel entrance/exit ramps at Walnut Canyon TI	205.0	205.0			4	each	\$ 979,000	\$ 3,916,000	\$ 117,000	\$ 392,000	\$ -	\$ 4,425,000
		TOTAL								\$ 7,832,000	\$ 234,000	\$ 784,000	\$ -	\$ 8,850,000
40.11	West of Walnut Canyon Pavement	Concrete Reconstruction (EB)	202.0	205.0	3			mile	\$3,810,000	\$11,430,000	\$ 343,000	\$ 1,143,000	\$ -	\$ 12,916,000
40.12	Canyon Diablo West Safety Improvements	Improve skid resistance (reconstruct pavement, increase superelevation, or mill and replace)	218.0	220.0	4			mile	\$1,470,000	\$ 5,880,000	\$176,000	\$ 588,000	\$ -	\$ 6,644,000
		Install chevrons and curve warning signs	218.0	220.0	4			mile	\$ 40,500	\$ 162,000	\$ 5,000	\$ 16,000		\$ 183,000
		Install dynamic speed feedback system (EB)	218.0	218.0			1	each	\$ 55,000	\$ 55,000	\$ 2,000	\$ 6,000		\$ 63,000
		Install dynamic speed feedback system (WB)	220.0	220.0			1	each	\$ 55,000	\$ 55,000	\$ 2,000	\$ 6,000		\$ 63,000
		Install safety edge	218.0	220.0	4			mile	\$ 176,000	\$ 704,000	\$ 21,000	\$ 70,000		\$ 795,000
		Enhance delineation (striping, delineators, rumble strips)	218.0	220.0	4			mile	\$ 50,100	\$ 200,400	\$ 6,000	\$ 20,000		\$ 226,400
		Rehabilitate/widen inside shoulder	218.0	220.0	4			mile	\$ 460,000	\$ 1,840,000	\$ 55,000	\$ 184,000		\$ 2,079,000
		TOTAL								\$ 8,896,400	\$ 267,000	\$ 890,000		\$ 10,053,400
40.13	Canyon Diablo Safety Improvement	Install safety edge	220.0	229.0	18			mile	\$ 176,000	\$ 3,168,000	\$ 95,000	\$ 317,000		\$ 3,580,000
		Enhance delineation (striping, delineators, rumble strips)	220.0	229.0	18			mile	\$ 50,100	\$ 901,800	\$ 27,000	\$ 90,000		\$ 1,018,800
		Rehabilitate/widen inside shoulder	220.0	229.0	18			mile	\$ 460,000	\$ 8,280,000	\$ 248,000	\$ 828,000		\$ 9,356,000
		Install Roadside Weather Information System (RWIS)	222.0	223.0			1	each	\$ 132,000	\$ 132,000	\$ 4,000	\$ 13,000		\$ 149,000
		Install dynamic wind warning system	222.0	223.0			1	each	\$ 88,000	\$ 88,000	\$ 3,000	\$ 9,000		\$ 100,000
		TOTAL								\$12,569,800	\$ 377,000	\$ 1,257,000		\$ 14,203,800
40.14	Twin Arrows TI	Construct/extend parallel entrance/exit ramps at Twin Arrows TI	220.0	220.0			4	each	\$ 979,000	\$ 3,916,000	\$ 117,000	\$ 392,000		\$ 4,425,000
40.15	Canyon Diablo East Safety Improvements	Improve skid resistance (reconstruct pavement, increase superelevation, or mill and replace)	229.0	230.0	2			mile	\$ 1,470,000	\$ 2,940,000	\$ 88,000	\$ 294,000	\$ -	\$ 3,322,000
		Install chevrons and curve warning signs	229.0	230.0	2			mile	\$ 40,500	\$ 81,000	\$ 2,000	\$ 8,000	\$ -	\$ 91,000
		Install dynamic speed feedback system (WB)	230.0	230.0			1	each	\$ 55,000	\$ 55,000	\$ 2,000	\$ 6,000	\$ -	\$ 63,000
		Install dynamic speed feedback system (EB)	229.0	229.0			1	each	\$ 55,000	\$ 55,000	\$ 2,000	\$ 6,000	\$ -	\$ 63,000
		Install safety edge	229.0	230.0	2			mile	\$ 176,000	\$ 352,000	\$ 11,000	\$ 35,000	\$ -	\$ 398,000
		Enhance delineation (striping, delineators, rumble strips)	229.0	230.0	2			mile	\$ 50,100	\$ 100,200	\$ 3,000	\$ 10,000	\$ -	\$ 113,200
		Rehabilitate/widen inside shoulder	229.0	230.0	2			mile	\$ 460,000	\$ 920,000	\$ 28,000	\$ 92,000	\$ -	\$ 1,040,000
		Retrofit Roadside Weather Information System (RWIS)	230.0	230.0			1	each	\$ 132,000	\$ 132,000	\$ 4,000	\$ 13,000		\$ 149,000

I-40 Corridor Solution Cost Estimates											PE	Design	ROW	Total
CS #	Project Name	Solution	BMP	EMP	Length	Sq Ft	Each	Unit	Unit Cost	Total Construction Cost	0.03	0.10	-	
		TOTAL								\$ 4,635,200	\$ 140,000	\$ 464,000		\$ 5,239,200
40.17	East Winslow Safety Improvements	Improve skid resistance (reconstruct pavement, increase superelevation, or mill and replace)	258.0	260.0	4			mile	\$1,470,000	\$5,880,000	\$ 176,000	\$ 588,000	\$ -	\$ 6,644,000
		Install dynamic speed feedback system (WB)	260.0	260.0			1	each	\$ 55,000	\$ 55,000	\$ 2,000	\$ 6,000	\$ -	\$ 63,000
		Install dynamic speed feedback system (EB)	258.0	258.0			1	each	\$ 55,000	\$ 55,000	\$ 2,000	\$ 6,000	\$ -	\$ 63,000
		Install safety edge	258.0	266.0	16			mile	\$ 176,000	\$ 2,816,000	\$84,000	\$ 282,000	\$ -	\$ 3,182,000
		Enhance delineation (striping, delineators, rumble strips)	258.0	266.0	16			mile	\$ 50,100	\$ 801,600	\$ 24,000	\$ 80,000	\$ -	\$ 905,600
		Install CCTV camera on existing DMS (WB)	260.2	260.2			1	each	\$ 55,000	\$ 55,000	\$ 2,000	\$ 6,000	\$ -	\$ 63,000
		TOTAL								\$ 9,662,600	\$ 290,000	\$ 968,000	\$ -	\$ 10,920,600
40.24	Lupton West Safety Improvements	Improve skid resistance (reconstruct pavement, increase superelevation, or mill and replace)	varies	varies	5			mile	\$1,470,000	\$7,350,000	\$176,000	\$ 588,000	\$ -	\$ 8,114,000
		Install dynamic speed feedback system (EB)	345.0	345.0			1	each	\$ 55,000	\$ 55,000	\$ 2,000	\$ 6,000	\$ -	\$ 63,000
		Install dynamic speed feedback system (WB)	351.0	351.0			1	each	\$55,000	\$ 55,000	\$ 2,000	\$ 6,000	\$ -	\$ 63,000
		Install chevrons and curve warning signs	345.0	351.0	12			mile	\$40,500	\$ 486,000	\$ 15,000	\$ 49,000	\$ -	\$ 550,000
		Install dynamic wind warning system	349.0	350.0			1	each	\$88,000	\$ 88,000	\$ 3,000	\$ 9,000	\$ -	\$ 100,000
		Enhance delineation (striping, delineators, rumble strips)	345.0	351.0	12			mile	\$50,100	601,200	\$ 18,000	\$ 60,000	\$ -	\$ 679,200
		Install safety edge	345.0	351.0	12			mile	\$ 176,000	\$ 2,112,000	\$ 63,000	\$ 211,000	\$ -	\$ 2,386,000
		Install Roadside Weather Information System (RWIS)					1	each	\$ 132,000	\$ 132,000	\$ 4,000	\$ 13,000	\$ -	\$ 149,000
		TOTAL								\$10,879,200	\$ 283,000	\$ 942,000		\$12,104,200
40.25	Lupton East Safety Improvements	Enhance delineation (striping, delineators, rumble strips)	351.0	360.0	18			mile	\$ 50,100	\$ 901,800	\$ 27,000	\$ 90,000	\$ -	\$ 1,018,800
		Install safety edge	351.0	360.0	18			mile	\$ 176,000	\$ 3,168,000	\$ 95,000	\$ 317,000	\$ -	\$ 3,580,000
		TOTAL								\$ 4,069,800	\$122,000	\$ 407,000		\$ 4,598,800
40.26	Lupton Area TI Improvements	Construct/extend parallel entrance/exit ramps at Houck TI	348.0	348.0			4	each	\$ 979,000	\$ 3,916,000	\$117,000	\$ 392,000	\$ -	\$ 4,425,000
		Construct/extend parallel entrance/exit ramps at Lupton TI	359.0	359.0			4	each	\$ 979,000	\$ 3,916,000	\$117,000	\$ 392,000	\$ -	\$ 4,425,000
		Construct/extend parallel entrance/exit ramps at WB rest area TI	359.0	359.0			1	each	\$ 979,000	\$ 979,000	\$ 29,000	\$ 98,000	\$ -	\$ 1,106,000
		TOTAL								\$8,811,000	\$ 263,000	\$ 882,000		\$9,956,000

Appendix B: Life-Cycle Cost Analysis

LONE TREE RD EB OP (#1180) / I-40 / MP 196.26									
Bridge Information			Deterioration Slope						
Bridge Deck Area (A225)		4355 SF			Item	Deterioration Line Equation			Year Drop
Year Built (N27)		1966				Slope =	Days	Years	
Exp Service Life		75 YR			Substr	y =	-0.000293x	-0.107x	9.35
Total Bridge Length (N49)		107 LF			Superstr	y =	-0.000450x	-0.164x	6.09
Number of Spans (N45+N46)		3			Deck	y =	-0.000357x	-0.130x	7.67
Skew Angle (N34)		26 DEG							
Average Elevation		6930 FT							
Max Pier Height		19 FT							
* Amount of Widening for Bridge		4.50 FT			Notes: 1. Widening is intended only to correct lane and/or shoulder width deficiencies. It is not intended for adding traffic capacity (i.e. adding general purpose lanes).				
Revised Deck Area (Bridge Replace)		4837 FT							
**Scour Critical Rating (N113)		N/A							
Cost Multipliers					L to # Span Multiplier			Skew Multiplier	
Elevation > 4000ft		6930	1.25	L/ # Span Ratio		Multiplier		Skew	Multiplier
Pier Height > 30ft		19	1.00	=>100		1.00		<30	1.00
Length to # span ratio		35.67	1.25	=>60		1.10		=>30	1.10
Skew > 30degrees		26.00	1.00	<60		1.25			
Project Cost Multiplier		All Options	2.20						
Adjusted Bridge Replace Cost					Elevation Multiplier			Pier H Multiplier	
Base Bridge Replacement Cost (Per SF)		\$125.00			Elev	Multiplier		Pier H	Multiplier
					<4000	1.00		<30	1.00
Bridge Replacement Cost w/ Multipliers (Per SF)		\$195.31			=>4000	1.25		=>30	1.10
						User input cell			
						Only manipulate cell value after consulting with team			

Bridge History (Inspections/As-builts)											
Description							Category			Year	
Original construction I-40-4(20)										1966	
Barrier replacement I-40-4(123)										1992	
Major column wall fill-in construction performed.							Rehab (Substr)			2003	
Latest inspection does not reveal any unusual activity in deck/superstructure - perform rehab on both superstructure/deck in option 2.											

Replace / Rehab / Repair Information				
BRIDGE DECK				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Deck)	Full Deck Replacement	\$97.66	25	Rating = 8
Rehab (Deck Concrete Overlay)	Overlay (Concrete)	\$10.00	15	+ 2
Rehab (Deck Epoxy Overlay)	Overlay (Epoxy)	\$5.00	10	+ 1
Repair (Deck)	Patch Spalls / Seal Cracks	\$3.00	See Deterioration Slope	+ 0
Replace (Bridge)	Full Bridge Replacement	\$195.31	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 0
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 0
SUPERSTRUCTURE - STEEL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Stl)	Full SuperStr Replacement	\$97.66	50	Rating = 8
Rehab (Supr - Stl)	Weld New Structural Components	\$48.83	15	+ 2
Repair (Supr - Stl)	Weld Repair / Crack Relief	\$5.00	See Deterioration Slope	+ 1
SUPERSTRUCTURE - CONCRETE				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Conc)	Full SuperStr Replacement	\$97.66	50	Rating = 8
Rehab (Supr - Conc)	Replace Structural Component	\$48.83	15	+ 2
Repair (Supr - Conc)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	\$195.31	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 1
SUBSTRUCTURE - STRUCTURAL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Substr)	Full SubStr Replacement	\$97.66	75	Rating = 8
Rehab (Substr)	Replace Structural Component	\$48.83	50	+ 2
Repair (Substr)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
SUBSTRUCTURE - SCOUR				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Rehab (Substr - Scour)	Add scour protection slabs	\$48.83	50	+ 2
Repair (Substr - Scour)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	\$195.31	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 1

LONE TREE RD EB OP (#1180) / I-40 / MP 196.26																																												
Option 2 - Perform Bridge Rehabilitation Then Replace																																												
Bridge Deck Area =		4355 SF																																										
Widen Deck Area =		4837 SF																																										
Year Built =		1966																																										
Exp Service Life =		75 YR																																										
<div>Notes:</div> <div>1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.</div> <div>2. When superstructure replacement is selected, deck replacement should be selected as well.</div> <div>3. Deck Rehab does not account for any deck widening during replacement.</div> <div>4. Widened deck area applies to bridge replacement only.</div> <div>5. Repair deck (after bridge replace) should provide a deck deterioration of 1 point every 20 years. Repair (Deck) should maintain deck rating for life of repair, if the rating would otherwise drop a point (i.e., if the rating would drop from a "5" to a "4", Repair Deck would maintain a "5" at that year.)</div> <div>6. For other repair items, the "+" value rating should be applied to improve the bridge rating's value for that year.</div>																																												
<table><tr><th rowspan="2">Item</th><th colspan="3">Deterioration Line Equation</th><th rowspan="2">Year Drop</th></tr><tr><th>Slope =</th><th>Days</th><th>Years</th></tr><tr><td>Substr</td><td>y =</td><td>-0.000293x</td><td>-0.107x</td><td>9.35</td></tr><tr><td>Superstr</td><td>y =</td><td>-0.000450x</td><td>-0.164x</td><td>6.09</td></tr><tr><td>Deck</td><td>y =</td><td>-0.000357x</td><td>-0.130x</td><td>7.67</td></tr></table>																						Item	Deterioration Line Equation			Year Drop	Slope =	Days	Years	Substr	y =	-0.000293x	-0.107x	9.35	Superstr	y =	-0.000450x	-0.164x	6.09	Deck	y =	-0.000357x	-0.130x	7.67
Item	Deterioration Line Equation			Year Drop																																								
	Slope =	Days	Years																																									
Substr	y =	-0.000293x	-0.107x	9.35																																								
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Deck	y =	-0.000357x	-0.130x	7.67																																								
Substructure							Superstructure							Deck							Summary																							
Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 \$ raw costs)	Present Value at 3%	Present Value at 7%																						
0	2015	6	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.				5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.				5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.																															
1	2016	6																																										
2	2017	6																																										
3	2018	6																																										
4	2019	6																																										
5	2020	6					5					5																																
6	2021	5	Repair (Substr)	\$5.00	\$21,775.00	9	+ 1	7	Rehab (Supr - Conc)	\$48.83	\$212,643.76	15	+ 2	7	Rehab (Deck Concrete Overlay)	\$10.00	\$43,550.00	15	+ 2	5	\$256,193.76	\$214,558.24	\$170,712.72																					
7	2022	5						7					7					5					5																					
8	2023	5						7					7					5					5																					
9	2024	5						7					7					5					5																					
10	2025	5						7					7					5					5																					
11	2026	5						7					7					5					5																					
12	2027	5						7					7					5					5																					
13	2028	5						7					7					5					5																					
14	2029	5						6					6					6					5																					
15	2030	4						6					6					6					4																					
16	2031	5						6					6					6					5	\$21,775.00	\$13,569.46	\$7,375.95																		
17	2032	5						6					6					6					5																					
18	2033	5						6					6					6					5																					
19	2034	5						6					6					6					5																					
20	2035	5						6					6					6					5																					
21	2036	5	6					6					6					5																										
22	2037	5	5					5					5					5																										
23	2038	5	6					6	Repair (After Rehab)	\$3.00	\$13,065.00	10	+ 1	6	Repair (After Rehab)	\$3.00	\$13,065.00	10	+ 0	5	\$26,130.00	\$13,239.86	\$5,512.04																					
24	2039	4	6					6					6					4																										
25	2040	5	6					6					6					5	\$21,775.00	\$10,399.86	\$4,012.03																							
26	2041	8	Replace (Bridge)	\$195.31	\$944,616.82	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	\$944,616.82	\$438,013.84	\$162,658.76																					
27	2042	8						8						8					8																									
28	2043	8						8						8					8																									
29	2044	8						8						8					8																									
30	2045	8						8						8					8																									
31	2046	8						8						8					8																									
32	2047	8						8						8					8																									
33	2048	8						8						8					8																									
34	2049	8						8						8					8																									
35	2050	8						8						8					8																									
36	2051	7						7						7					7																									
37	2052	7						7						7					7																									
38	2053	7						7						7					7																									
39	2054	7						7						7					7																									
40	2055	7						7						7					7																									
41	2056	7						7						7					7																									
42	2057	7						7						7					7																									
43	2058	7						7						7					7																									
44	2059	7						7						7					7																									
45	2060	6						6						6					6																									
46	2061	7	Repair (After Bridge Replace)	\$3.00	\$14,509.50	20	+ 1	7	Repair (After Bridge Replace)	\$3.00	\$14,509.50	20	+ 1	7	Repair (After Bridge Replace)	\$3.00	\$14,509.50	20	+ 0	7	\$43,528.50	\$11,175.36	\$1,936.96																					
47	2062	7						7						7					7																									
48	2063	7						7						7					7																									
49	2064	7						7						7					7																									
50	2065	7						7						7					7																									
51	2066	7						7						7					7																									
52	2067	7						7						7					7																									
53	2068	7						7						7					7																									
54	2069	7						7						7					7																									
55	2070	7						7						7					7																									
56	2071	6						6						6					6																									
57	2072	6						6						6					6																									
58	2073	6						6						6					6																									
59	2074	6						6						6					6																									
60	2075	6						6						6					6																									
61	2076	6						6						6					6																									
62	2077	6						6						6					6																									
63	2078	6						6						6					6																									
64	2079	6						6						6					6																									
65	2080	5						5						5					5																									
Total Cost =																			\$1,314,019.08		\$700,956.61		\$352,208.45																					
Average Rating =																			6.27																									
End Rating =																			5																									
Comments:																																												

LONE TREE RD EB OP (#1180) / I-40 / MP 196.26																															
Option 3 - Perform Minimum Repairs Then Replace																															
Bridge Deck Area = 4355 SF			<div>Notes:</div> <div>1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.</div> <div>2. When superstructure replacement is selected, deck replacement should be selected as well.</div> <div>3. Deck Rehab does not account for any deck widening during replacement.</div> <div>4. Widened deck area applies to bridge replacement only.</div> <div>5. Repair deck (after bridge replace) should provide a deck deterioration of 1 point every 20 years. Repair (Deck) should maintain deck rating for life of repair, if the rating would otherwise drop a point (i.e., if the rating would drop from a "5" to a "4", Repair Deck would maintain a "5" at that year.</div> <div>6. For other repair items, the "+" value rating should be applied to improve the bridge rating's value for that year.</div>										Item			Deterioration Line Equation			Year Drop												
Widen Deck Area = 4837 SF													Substr			Slope = y = -0.000293x			Days -0.107x			Years 9.35									
Year Built = 1966													Superstr			y = -0.000450x			-0.164x			6.09									
Exp Service Life = 75 YR													Deck			y = -0.000357x			-0.130x			7.67									
Substructure							Superstructure							Deck							Summary										
Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 \$ raw costs)	Present Value at 3%	Present Value at 7%									
0	2015	6	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.				5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.				5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.																		
1	2016	6																													
2	2017	6																													
3	2018	6																													
4	2019	6																													
5	2020	6					5					5																			
6	2021	5	Repair (Substr)				4	Repair (Supr - Conc)				5	Repair (Deck)				4														
7	2022	5																													
8	2023	5																													
9	2024	5																													
10	2025	5																													
11	2026	5																													
12	2027	5																													
13	2028	5																													
14	2029	5																													
15	2030	4																													
16	2031	5																													
17	2032	5																													
18	2033	5																													
19	2034	5																													
20	2035	5																													
21	2036	5																													
22	2037	5																													
23	2038	5																													
24	2039	4																													
25	2040	5																													
26	2041	8																													
27	2042	8																													
28	2043	8																													
29	2044	8																													
30	2045	8																													
31	2046	8																													
32	2047	8																													
33	2048	8																													
34	2049	8																													
35	2050	8																													
36	2051	7																													
37	2052	7																													
38	2053	7																													
39	2054	7																													
40	2055	7																													
41	2056	7																													
42	2057	7																													
43	2058	7																													
44	2059	7																													
45	2060	6																													
46	2061	7																													
47	2062	7																													
48	2063	7																													
49	2064	7																													
50	2065	7																													
51	2066	7																													
52	2067	7																													
53	2068	7																													
54	2069	7																													
55	2070	7																													
56	2071	6																													
57	2072	6																													
58	2073	6																													
59	2074	6																													
60	2075	6																													
61	2076	6																													
62	2077	6																													
63	2078	6																													
64	2079	6																													
65	2080	5																													
																			Total Cost =	\$1,136,215.32	\$541,422.65	\$217,394.94									
																			Average Rating =	6.22											
																			End Rating =	5											
Comments:																															

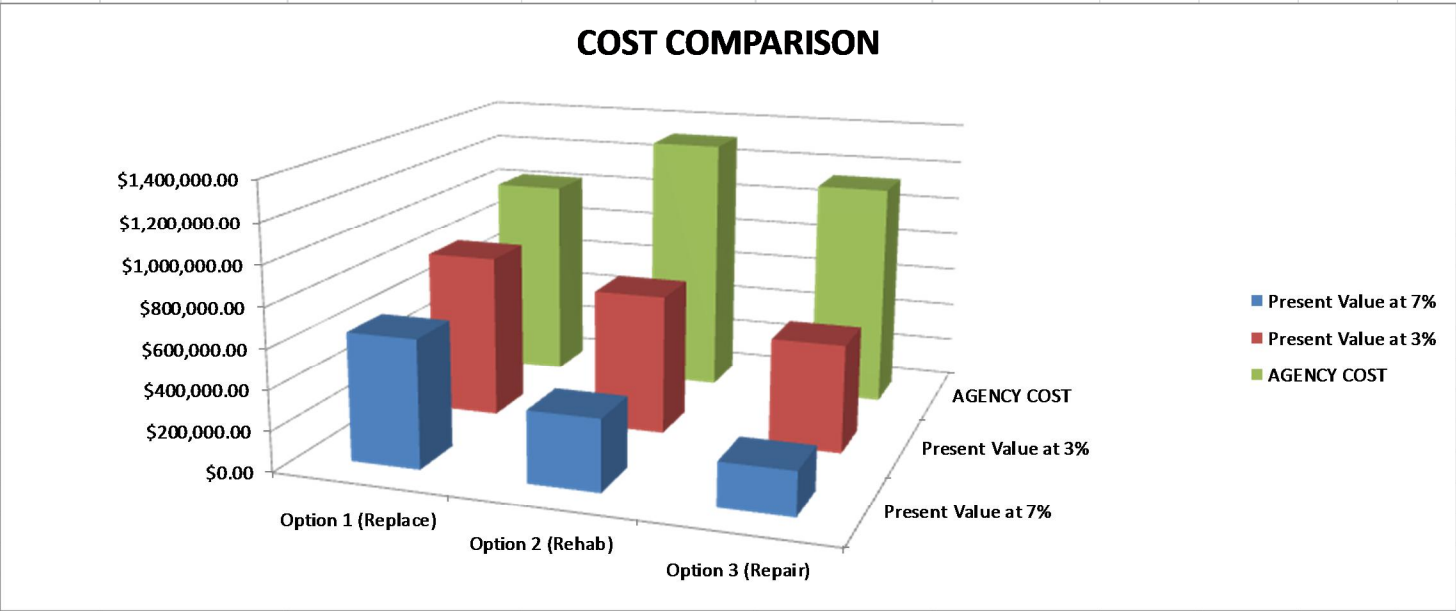
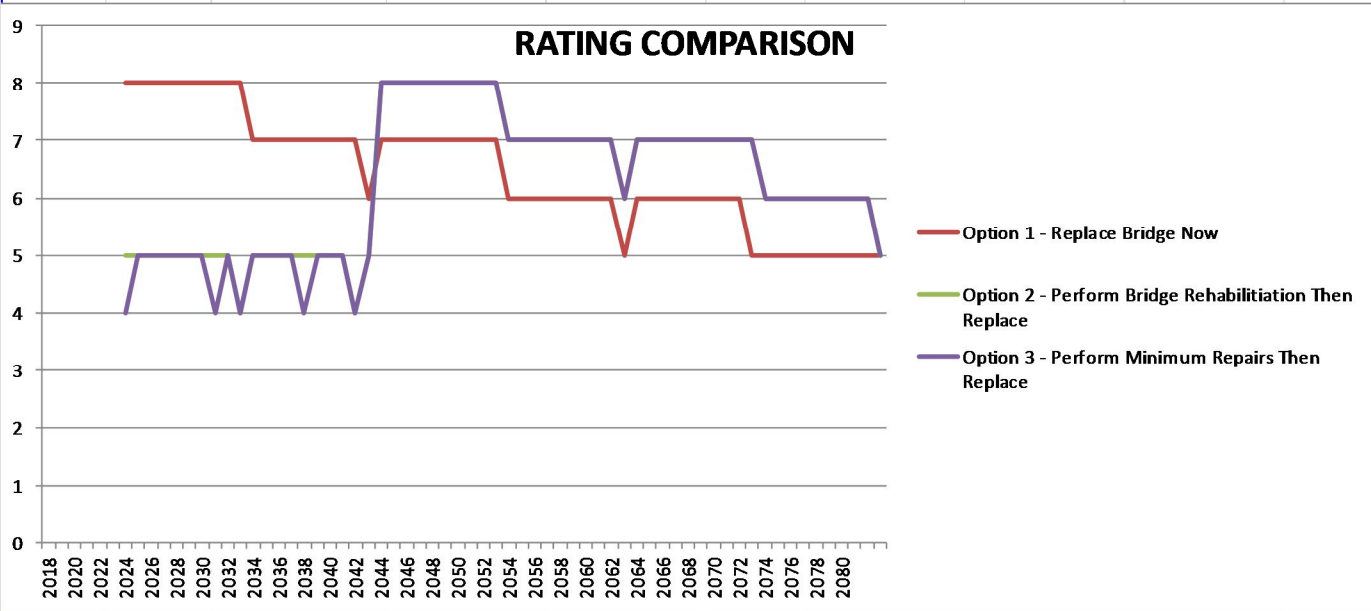
LONE TREE RD EB OP (#1180) / I-40 / MP 196.26

COST COMPARISON Present Value 2015 Dollars - Raw Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$ 1,031,673.82	\$822,461.00	\$638,870.44
Option 2 (Rehab)	\$ 1,314,019.08	\$700,956.61	\$352,208.45
Option 3 (Repair)	\$ 1,136,215.32	\$541,422.65	\$217,394.94

Comparison to Replacement			
Option	Agency Cost	3%	7%
2 (Rehab)	78.51%	117.33%	181.39%
3 (Repair)	90.80%	151.91%	293.88%

COST COMPARISON Present Value 2015 Dollars - Fully Loaded Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$2,269,682	\$1,809,414	\$1,405,515
Option 2 (Rehab)	\$2,890,842	\$1,542,105	\$774,859
Option 3 (Repair)	\$2,499,674	\$1,191,130	\$478,269

Bridge Ratings Per Option		
OPTION	AVG RATING	END RATING
Option 1 (Replace)	6.45	5
Option 2 (Rehab)	6.27	5
Option 3 (Repair)	6.22	5



LONE TREE RD WB OP (#1181) / I-40 / MP 196.26									
Bridge Information			Deterioration Slope						
Bridge Deck Area (A225)		4355 SF	Item	Deterioration Line Equation			Year Drop		
Year Built (N27)		1966		Slope =		Days		Years	
Exp Service Life		75 YR	Substr	y =		-0.000433x	-0.158x	6.32	
Total Bridge Length (N49)		107 LF	Superstr	y =		-0.000519x	-0.189x	5.28	
Number of Spans (N45+N46)		3	Deck	y =		-0.000357x	-0.130x	7.67	
Skew Angle (N34)		27 DEG							
Average Elevation		6930 FT							
Max Pier Height		14 FT							
* Amount of Widening for Bridge		4.50 FT	*Input 0 if no widening. Input should include widening on both sides of bridge if applicable. **If scour critical rating is 3 or lower, Option 2 should consider the implementation of scour countermeasures.				Notes: 1. Widening is intended only to correct lane and/or shoulder width deficiencies. It is not intended for adding traffic capacity (i.e. adding general purpose lanes).		
Revised Deck Area (Bridge Replace)		4837 FT							
**Scour Critical Rating (N113)		N/A							
Cost Multipliers			L to # Span Multiplier				Skew Multiplier		
Elevation > 4000ft		6930	1.25	L/ # Span Ratio		Multiplier		Skew	Multiplier
Pier Height > 30ft		14	1.00	=>100		1.00		<30	1.00
Length to # span ratio		35.67	1.25	=>60		1.10		=>30	1.10
Skew > 30degrees		27.00	1.00	<60		1.25			
Project Cost Multiplier		All Options	2.20						
Adjusted Bridge Replace Cost			Elevation Multiplier				Pier H Multiplier		
Base Bridge Replacement Cost (Per SF)		\$125.00	Elev	Multiplier			Pier H	Multiplier	
			<4000	1.00			<30	1.00	
Bridge Replacement Cost w/ Multipliers (Per SF)		\$195.31	=>4000	1.25			=>30	1.10	
							User input cell		
							Only manipulate cell value after consulting with team		

Bridge History (Inspections/As-builts)											
Description							Category			Year	
Original construction I-40-4(20)										1966	
Barrier replacement I-40-4(131)										1992	
Major column wall fill-in construction performed.							Rehab (Substr)			2003	
Latest inspection does not reveal any unusual activity in deck/superstructure - perform rehab on both superstructure/deck in option 2.											

Replace / Rehab / Repair Information				
BRIDGE DECK				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Deck)	Full Deck Replacement	\$97.66	25	Rating = 8
Rehab (Deck Concrete Overlay)	Overlay (Concrete)	\$10.00	15	+ 2
Rehab (Deck Epoxy Overlay)	Overlay (Epoxy)	\$5.00	10	+ 1
Repair (Deck)	Patch Spalls / Seal Cracks	\$3.00	See Deterioration Slope	+ 0
Replace (Bridge)	Full Bridge Replacement	\$195.31	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 0
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 0
SUPERSTRUCTURE - STEEL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Stl)	Full SuperStr Replacement	\$97.66	50	Rating = 8
Rehab (Supr - Stl)	Weld New Structural Components	\$48.83	15	+ 2
Repair (Supr - Stl)	Weld Repair / Crack Relief	\$5.00	See Deterioration Slope	+ 1
SUPERSTRUCTURE - CONCRETE				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Conc)	Full SuperStr Replacement	\$97.66	50	Rating = 8
Rehab (Supr - Conc)	Replace Structural Component	\$48.83	15	+ 2
Repair (Supr - Conc)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	\$195.31	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 1
SUBSTRUCTURE - STRUCTURAL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Substr)	Full SubStr Replacement	\$97.66	75	Rating = 8
Rehab (Substr)	Replace Structural Component	\$48.83	50	+ 2
Repair (Substr)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
SUBSTRUCTURE - SCOUR				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Rehab (Substr - Scour)	Add scour protection slabs	\$48.83	50	+ 2
Repair (Substr - Scour)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	\$195.31	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 1

September 2016

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I-40 East

LONE TREE RD WB OP (#1181) / I-40 / MP 196.26																										
Option 2 - Perform Bridge Rehabilitation Then Replace																										
Bridge Deck Area = 4355 SF				<div>Notes:</div> <div>1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.</div> <div>2. When superstructure replacement is selected, deck replacement should be selected as well.</div> <div>3. Deck Rehab does not account for any deck widening during replacement.</div> <div>4. Widened deck area applies to bridge replacement only.</div> <div>5. Repair deck (after bridge replace) should provide a deck deterioration of 1 point every 20 years. Repair (Deck) should maintain deck rating for life of repair, if the rating would otherwise drop a point (i.e., if the rating would drop from a "5" to a "4", Repair Deck would maintain a "5" at that year.)</div> <div>6. For other repair items, the "+" value rating should be applied to improve the bridge rating's value for that year.</div>															Item		Deterioration Line Equation			Year Drop		
Widen Deck Area = 4837 SF																			Slope =		Days		Years			
Year Built = 1966																			y =		-0.000433x		-0.158x		6.32	
Exp Service Life = 75 YR																			y =		-0.000519x		-0.189x		5.28	
				y =		-0.000357x		-0.130x		7.67																
Substructure							Superstructure							Deck							Summary					
	Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 \$ raw costs)	Present Value at 3%	Present Value at 7%			
0	2015	6	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.											
1	2016	6						5						5												
2	2017	6						5						5												
3	2018	6						5						5												
4	2019	6						5						5												
5	2020	6						5						5												
6	2021	5	Repair (Substr)					7	Rehab (Supr - Conc)	\$48.83	\$212,643.76	15	+ 2	7	Rehab (Deck Concrete Overlay)	\$10.00	\$43,550.00	15	+ 2	5	\$256,193.76	\$214,558.24	\$170,712.72			
7	2022	5						7						7						5						
8	2023	5						7						7						5						
9	2024	5						7						7						5						
10	2025	5						7						7						5						
11	2026	5						7						7						5						
12	2027	4						7						7						4						
13	2028	5		\$5.00	\$21,775.00	6	+ 1	7						7						5	\$21,775.00	\$14,827.72	\$9,035.85			
14	2029	5						6						6						5						
15	2030	5						6						6						5						
16	2031	5						6						6						5						
17	2032	5	Repair (Substr)					6						6						5						
18	2033	5						6						6						5						
19	2034	4						6						6						5						
20	2035	5		\$5.00	\$21,775.00	6	+ 1	6						6						5	\$21,775.00	\$12,056.29	\$5,627.07			
21	2036	5						6						6						5						
22	2037	5						5						5	Repair (After Rehab)					5						
23	2038	5						6		\$3.00	\$13,065.00	10	+ 1	6		\$3.00	\$13,065.00	10	+ 0	5	\$26,130.00	\$13,239.86	\$5,512.04			
24	2039	5						6						6						5						
25	2040	5						6						6						5						
26	2041	8	Replace (Bridge)	\$195.31	\$944,616.82	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	\$944,616.82	\$438,013.84	\$162,658.76			
27	2042	8						8						8						8						
28	2043	8						8						8						8						
29	2044	8						8						8						8						
30	2045	8						8						8						8						
31	2046	8						8						8						8						
32	2047	8						8						8						8						
33	2048	8						8						8						8						
34	2049	8						8						8						8						
35	2050	8						8						8						8						
36	2051	7	Repair (After Bridge Replace)					7						7						7						
37	2052	7						7						7						7						
38	2053	7						7						7						7						
39	2054	7						7						7						7						
40	2055	7						7						7						7						
41	2056	7						7						7						7						
42	2057	7						7						7						7						
43	2058	7						7						7						7						
44	2059	7						7						7						7						
45	2060	6						6						6						6						
46	2061	7		\$3.00	\$14,509.50	20	+ 1	7		\$3.00	\$14,509.50	20	+ 1	7		\$3.00	\$14,509.50	20	+ 0	7	\$43,528.50	\$11,175.36	\$1,936.96			
47	2062	7						7						7						7						
48	2063	7						7						7						7						
49	2064	7						7						7						7						
50	2065	7						7						7						7						
51	2066	7						7						7						7						
52	2067	7						7						7						7						
53	2068	7						7						7						7						
54	2069	7						7						7						7						
55	2070	7						7						7						7						
56	2071	6						6						6						6						
57	2072	6						6						6						6						
58	2073	6						6						6						6						
59	2074	6						6						6						6						
60	2075	6						6						6						6						
61	2076	6						6						6						6						
62	2077	6						6						6						6						
63	2078	6						6						6						6						
64	2079	6						6						6						6						
65	2080	5						5						5						5						
																				Total Cost =	\$1,314,019.08	\$703,871.30	\$355,483.40			
																				Average Rating =	6.27					
																				End Rating =	5					
Comments:																										

LONE TREE RD WB OP (#1181) / I-40 / MP 196.26																							
Option 3 - Perform Minimum Repairs Then Replace																							
Bridge Deck Area =		4355 SF																					
Widen Deck Area =		4837 SF																					
Year Built =		1966																					
Exp Service Life =		75 YR																					
<div>Notes:</div> <div>1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.</div> <div>2. When superstructure replacement is selected, deck replacement should be selected as well.</div> <div>3. Deck Rehab does not account for any deck widening during replacement.</div> <div>4. Widened deck area applies to bridge replacement only.</div> <div>5. Repair deck (after bridge replce) should provide a deck deterioration of 1 point every 20 years. Repair (Deck) should maintain deck rating for life of repair, if the rating would otherwise drop a point (i.e., if the rating would drop from a "5" to a "4", Repair Deck would maintain a "5" at that year.</div> <div>6. For other repair items, the "+" value rating should be applied to improve the bridge rating's value for that year.</div>																							
<div><div><div>Substructure</div><div>Superstructure</div><div>Deck</div></div><div>Summary</div></div>																							
Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 \$ raw costs)	Present Value at 3%	Present Value at 7%	
0	2015	6	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.				5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.				5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.										
1	2016	6																					
2	2017	6																					
3	2018	6																					
4	2019	6																					
5	2020	6					5					5											
6	2021	5	Repair (Substr)				4	Repair (Supr - Conc)	\$5.00	\$21,775.00	5	+ 1	5	Repair (Deck)	\$3.00	\$13,065.00	8	+ 0	4				
7	2022	5					5						5						5	\$21,775.00	\$17,705.07	\$13,560.38	
8	2023	5					5						5						5	\$13,065.00	\$10,313.63	\$7,603.95	
9	2024	5					5						5						5				
10	2025	5					5						5						5				
11	2026	5					5						5						5				
12	2027	4					4						5						4				
13	2028	5		\$5.00	\$21,775.00	6	+ 1	5	Repair (Supr - Conc)	\$5.00	\$21,775.00	5	+ 1	5					5	\$43,550.00	\$29,655.43	\$18,071.70	
14	2029	5						5						5					5				
15	2030	5						5						5					5				
16	2031	5	Repair (Substr)				5						5	Repair (Deck)	\$3.00	\$13,065.00	8	+ 0	5	\$13,065.00	\$8,141.68	\$4,425.57	
17	2032	5					5						5						5				
18	2033	5					4						5						4				
19	2034	4					5	Repair (Supr - Conc)	\$5.00	\$21,775.00	5	+ 1	5						4	\$21,775.00	\$12,417.98	\$6,020.97	
20	2035	5		\$5.00	\$21,775.00	6	+ 1	5					5						5	\$21,775.00	\$12,056.29	\$5,627.07	
21	2036	5						5						5					5				
22	2037	5						5						5					5				
23	2038	5						5						5					5				
24	2039	5						4						5	Repair (Deck)	\$3.00	\$13,065.00	8	+ 0	4	\$13,065.00	\$6,427.11	\$2,575.72
25	2040	5						5	Repair (Supr - Conc)	\$5.00	\$21,775.00	5	+ 1	5	Replace (Bridge)				75	Rating = 8	5	\$21,775.00	\$10,399.86
26	2041	8	Replace (Bridge)	\$195.31	\$944,616.82	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)					8	\$944,616.82	\$438,013.84	\$162,658.76
27	2042	8	Repair (After Bridge Replace)				8						8						8				
28	2043	8						8						8						8			
29	2044	8						8						8						8			
30	2045	8						8						8						8			
31	2046	8						8						8						8			
32	2047	8						8						8						8			
33	2048	8						8						8						8			
34	2049	8						8						8						8			
35	2050	8						8						8						8			
36	2051	7						7						7						7			
37	2052	7						7						7						7			
38	2053	7						7						7						7			
39	2054	7						7						7						7			
40	2055	7						7						7						7			
41	2056	7						7						7						7			
42	2057	7						7						7						7			
43	2058	7						7						7						7			
44	2059	7						7						7						7			
45	2060	6						6						6						6			
46	2061	7		\$3.00	\$14,509.50	20	+ 1	7	Repair (After Bridge Replace)	\$3.00	\$14,509.50	20	+ 1	7	Repair (After Bridge Replace)	\$3.00	\$14,509.50	20	+ 0	7	\$43,528.50	\$11,175.36	\$1,936.96
47	2062	7						7						7						7			
48	2063	7						7						7						7			
49	2064	7						7						7						7			
50	2065	7						7						7						7			
51	2066	7						7						7						7			
52	2067	7						7						7						7			
53	2068	7						7						7						7			
54	2069	7						7						7						7			
55	2070	7						7						7						7			
56	2071	6						6						6						6			
57	2072	6						6						6						6			
58	2073	6						6						6						6			
59	2074	6						6						6						6			
60	2075	6						6						6						6			
61	2076	6						6						6						6			
62	2077	6						6						6						6			
63	2078	6						6						6						6			
64	2079	6						6						6						6			
65	2080	5						5						5						5			
Total Cost =																				\$1,157,990.32	\$556,306.24	\$226,493.10	
Average Rating =																				6.22			
End Rating =																				5			
Comments:																							

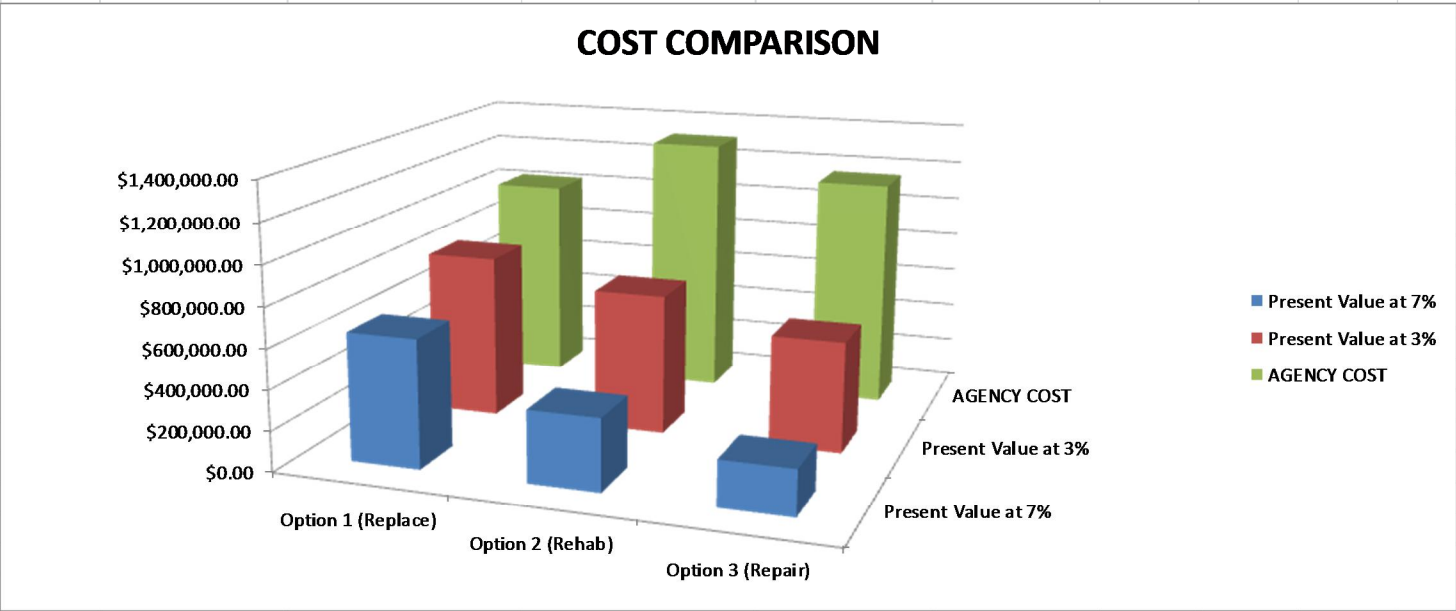
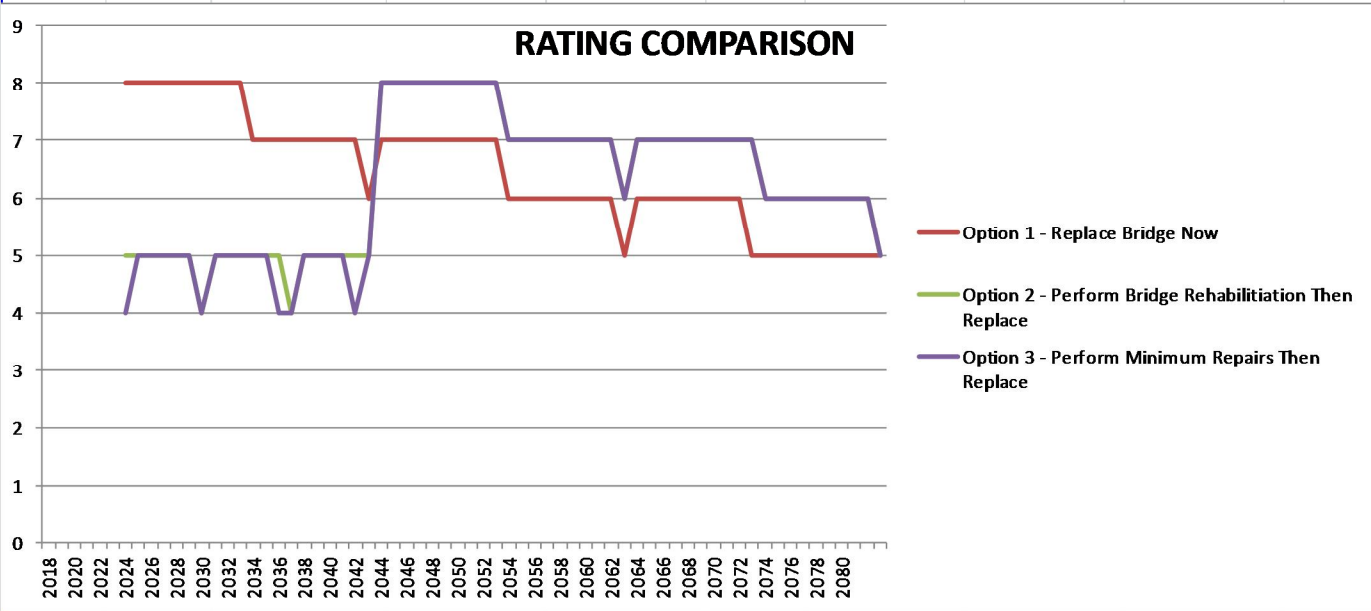
LONE TREE RD WB OP (#1181) / I-40 / MP 196.26

COST COMPARISON Present Value 2015 Dollars - Raw Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$ 1,031,673.82	\$822,461.00	\$638,870.44
Option 2 (Rehab)	\$ 1,314,019.08	\$703,871.30	\$355,483.40
Option 3 (Repair)	\$ 1,157,990.32	\$556,306.24	\$226,493.10

Comparison to Replacement			
Option	Agency Cost	3%	7%
2 (Rehab)	78.51%	116.85%	179.72%
3 (Repair)	89.09%	147.84%	282.07%

COST COMPARISON Present Value 2015 Dollars - Fully Loaded Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$2,269,682	\$1,809,414	\$1,405,515
Option 2 (Rehab)	\$2,890,842	\$1,548,517	\$782,063
Option 3 (Repair)	\$2,547,579	\$1,223,874	\$498,285

Bridge Ratings Per Option		
OPTION	AVG RATING	END RATING
Option 1 (Replace)	6.45	5
Option 2 (Rehab)	6.27	5
Option 3 (Repair)	6.22	5



Bridge History (Inspections/As-builts)											
Description							Category			Year	
Bridge originally built I-40-4(42).										1970	
Parapets replaced IR-40-4(122).							Repair (Deck)			1992	
Approach slabs removed/replaced I-040-D(1)P.										2001	
Parapet/guardrail repair I-040-D(221)A.							Repair (Deck)			2013	
Latest bridge inspection recommends "rehabilitate bridge deck."											

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BUFFALO RANGE TI OP WB (#1387) / I-40 / MP 225.05																									
Option 3 - Perform Minimum Repairs Then Replace																									
Bridge Deck Area =		4301 SF		<div>Notes:</div> <div>1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.</div> <div>2. When superstructure replacement is selected, deck replacement should be selected as well.</div> <div>3. Deck Rehab does not account for any deck widening during replacement.</div> <div>4. Widened deck area applies to bridge replacement only.</div> <div>5. Repair deck (after bridge replace) should provide a deck deterioration of 1 point every 20 years. Repair (Deck) should maintain deck rating for life of repair, if the rating would otherwise drop a point (i.e., if the rating would drop from a "5" to a "4", Repair Deck would maintain a "5" at that year.</div> <div>6. For other repair items, the "+" value rating should be applied to improve the bridge rating's value for that year.</div>																					
Widen Deck Area =		4729 SF																							
Year Built =		1970																							
Exp Service Life =		75 YR																							
Substructure							Superstructure							Deck							Summary				
	Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 \$ raw costs)	Present Value at 3%	Present Value at 7%		
0	2015	6	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.										
1	2016	6						5								5									
2	2017	6						5								5									
3	2018	6						5								5									
4	2019	6						5								5									
5	2020	6						4						5											
6	2021	5	Repair (Substr)					5	Repair (Supr - Conc)	\$5.00	\$21,505.00	4	+ 1	5	Repair (Deck)	\$3.00	\$12,903.00	7	+ 0	5	\$34,408.00	\$28,816.16	\$22,927.50		
7	2022	5						5						5						5					
8	2023	5						5						5						5					
9	2024	5						5						5						5					
10	2025	5						4						5						4					
11	2026	5	Repair (Substr)					5	Repair (Supr - Conc)	\$5.00	\$21,505.00	4	+ 1	5	Repair (Deck)					5	\$21,505.00	\$15,535.67	\$10,216.87		
12	2027	4						5						5						4					
13	2028	5		\$5.00	\$21,505.00	6	+ 1	5						5	Repair (Deck)	\$3.00	\$12,903.00	7	+ 0	5	\$34,408.00	\$23,430.17	\$14,278.10		
14	2029	5						5						5						5					
15	2030	5						4						5						4					
16	2031	5	Repair (Substr)					5	Repair (Supr - Conc)	\$5.00	\$21,505.00	4	+ 1	5	Repair (Deck)					5	\$21,505.00	\$13,401.21	\$7,284.49		
17	2032	5						5						5						5					
18	2033	5						5						5						5					
19	2034	4						5						5						4					
20	2035	5		\$5.00	\$21,505.00	6	+ 1	4						5	Repair (Deck)	\$3.00	\$12,903.00	7	+ 0	4	\$34,408.00	\$19,050.88	\$8,891.68		
21	2036	5	Repair (Substr)					5	Repair (Supr - Conc)	\$5.00	\$21,505.00	4	+ 1	5	Repair (Deck)					5	\$21,505.00	\$11,560.00	\$5,193.74		
22	2037	5						5						5						5					
23	2038	5						5						5						5					
24	2039	5						5						5						5					
25	2040	5						4						5						4					
26	2041	4	Repair (Substr)					5	Repair (Supr - Conc)	\$5.00	\$21,505.00	4	+ 1	5	Repair (Deck)					4	\$21,505.00	\$9,971.76	\$3,703.06		
27	2042	5		\$5.00	\$21,505.00	6	+ 1	5						5	Repair (Deck)	\$3.00	\$12,903.00	7	+ 0	5	\$34,408.00	\$15,490.11	\$5,537.29		
28	2043	5						5						5						5					
29	2044	5						5						5						5					
30	2045	8	Replace (Bridge)	\$195.31	\$923,620.99	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	\$923,620.99	\$380,519.62	\$121,333.43		
31	2046	8	Repair (After Bridge Replace)					8						8						8					
32	2047	8						8						8						8					
33	2048	8						8						8						8					
34	2049	8						8						8						8					
35	2050	8						8						8						8					
36	2051	8						8						8						8					
37	2052	8						8						8						8					
38	2053	8						8						8						8					
39	2054	8						8						8						8					
40	2055	7						7						7						7					
41	2056	7						7						7						7					
42	2057	7						7						7						7					
43	2058	7						7						7						7					
44	2059	7						7						7						7					
45	2060	7						7						7						7					
46	2061	7						7						7						7					
47	2062	7						7						7						7					
48	2063	7						7						7						7					
49	2064	6						6						6						6					
50	2065	7		Repair (After Bridge Replace)	\$3.00	\$14,187.00	20	+ 1	7	Repair (After Bridge Replace)	\$3.00	\$14,187.00	20	+ 1	7	Repair (After Bridge Replace)	\$3.00	\$14,187.00	20	+ 0	7	\$42,561.00	\$9,708.47	\$1,444.85	
51	2066	7						7						7						7					
52	2067	7						7						7						7					
53	2068	7						7						7						7					
54	2069	7						7						7						7					
55	2070	7						7						7						7					
56	2071	7						7						7						7					
57	2072	7						7						7						7					
58	2073	7						7						7						7					
59	2074	7						7						7						7					
60	2075	6						6						6						6					
61	2076	6						6						6						6					
62	2077	6						6						6						6					
63	2078	6						6						6						6					
64	2079	6						6						6						6					
65	2080	6						6						6						6					
																				Total Cost =	\$1,189,833.99	\$527,484.02	\$200,811.01		
																				Average Rating =	6.13				
																				End Rating =	6				
Comments:																									

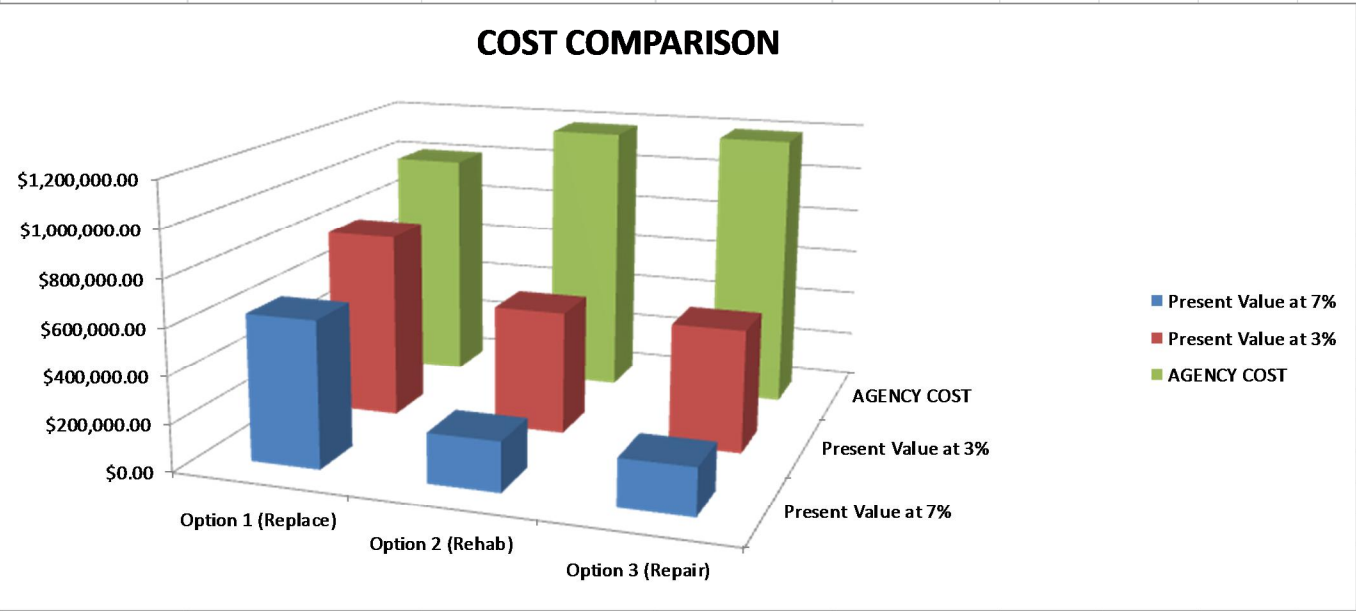
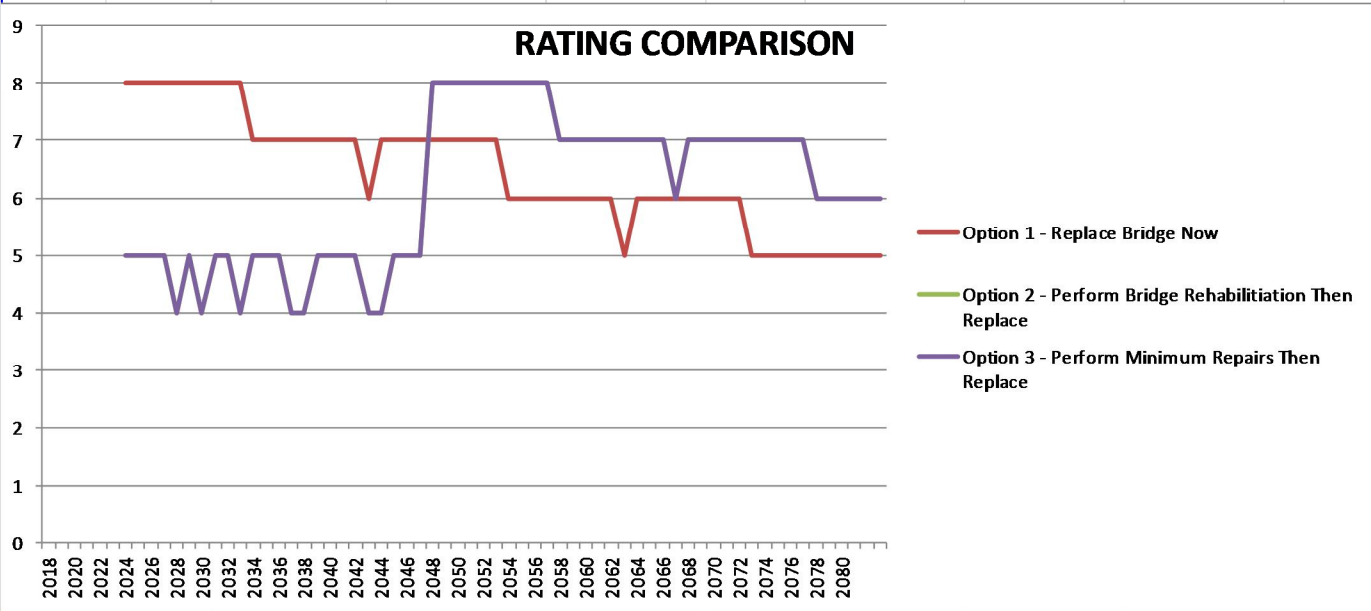
BUFFALO RANGE TI OP WB (#1387) / I-40 / MP 225.05

COST COMPARISON Present Value 2015 Dollars - Raw Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$ 1,008,742.99	\$804,180.31	\$624,670.38
Option 2 (Rehab)	\$ 1,181,231.99	\$530,958.98	\$210,107.43
Option 3 (Repair)	\$ 1,189,833.99	\$527,484.02	\$200,811.01

Comparison to Replacement			
Option	Agency Cost	3%	7%
2 (Rehab)	85.40%	151.46%	297.31%
3 (Repair)	84.78%	152.46%	311.07%

COST COMPARISON Present Value 2015 Dollars - Fully Loaded Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$2,219,235	\$1,769,197	\$1,374,275
Option 2 (Rehab)	\$2,598,710	\$1,168,110	\$462,236
Option 3 (Repair)	\$2,617,635	\$1,160,465	\$441,784

Bridge Ratings Per Option		
OPTION	AVG RATING	END RATING
Option 1 (Replace)	6.45	5
Option 2 (Rehab)	6.13	6
Option 3 (Repair)	6.13	6



LEROUX WASH BR EB (#1772) / I-40 / MP 284.31										
Bridge Information			Deterioration Slope							
Bridge Deck Area (A225)		19492 SF	Item	Deterioration Line Equation			Year Drop			
Year Built (N27)		1977		Slope =		Days		Years		
Exp Service Life		75 YR	Substr	y =		-0.000435x	-0.159x	6.31		
Total Bridge Length (N49)		439 LF	Superstr	y =		-0.000411x	-0.150x	6.67		
Number of Spans (N45+N46)		6	Deck	y =		-0.000137x	-0.050x	20.00		
Skew Angle (N34)		45 DEG								
Average Elevation		5072 FT								
Max Pier Height		8 FT								
* Amount of Widening for Bridge		0 FT	*Input 0 if no widening. Input should include widening on both sides of bridge if applicable. **If scour critical rating is 3 or lower, Option 2 should consider the implementation of scour countermeasures.				Notes:			
Revised Deck Area (Bridge Replace)		19492 FT					1. Widening is intended only to correct lane and/or shoulder width deficiencies. It is not intended for adding traffic capacity (i.e. adding general purpose lanes).			
**Scour Critical Rating (N113)		7								
Cost Multipliers			L to # Span Multiplier				Skew Multiplier			
Elevation > 4000ft		5072	1.25	L/ # Span Ratio		Multiplier		Skew	Multiplier	
Pier Height > 30ft		8	1.00	=>100		1.00		<30	1.00	
Length to # span ratio		73.17	1.1	=>60		1.10		=>30	1.10	
Skew > 30degrees		45.00	1.10	<60		1.25				
Project Cost Multiplier		All Options	2.20							
Adjusted Bridge Replace Cost			Elevation Multiplier				Pier H Multiplier			
Base Bridge Replacement Cost (Per SF)		\$125.00	Elev	Multiplier			Pier H	Multiplier		
			<4000	1.00			<30	1.00		
Bridge Replacement Cost w/ Multipliers (Per SF)		\$189.06	=>4000	1.25			=>30	1.10		
							User input cell			
							Only manipulate cell value after consulting with team			

Bridge History (Inspections/As-builts)											
Description							Category			Year	
Original construction I-40-4(30).										1977	
I-040-D-NFA provided scour protection.							Rehab (Substr - Scour)			2007	
I-040-D(223)T provided a new deck overlay.							Replace (Deck)			2015	
Cracks noted in superstructure and substructure is in poor condition. Consider rehab of both for option 2. Deck is already done (therefore 20 years).											

Replace / Rehab / Repair Information				
BRIDGE DECK				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Deck)	Full Deck Replacement	\$94.53	25	Rating = 8
Rehab (Deck Concrete Overlay)	Overlay (Concrete)	\$10.00	15	+ 2
Rehab (Deck Epoxy Overlay)	Overlay (Epoxy)	\$5.00	10	+ 1
Repair (Deck)	Patch Spalls / Seal Cracks	\$3.00	See Deterioration Slope	+ 0
Replace (Bridge)	Full Bridge Replacement	\$189.06	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 0
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 0
SUPERSTRUCTURE - STEEL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Stl)	Full SuperStr Replacement	\$94.53	50	Rating = 8
Rehab (Supr - Stl)	Weld New Structural Components	\$47.27	15	+ 2
Repair (Supr - Stl)	Weld Repair / Crack Relief	\$5.00	See Deterioration Slope	+ 1
SUPERSTRUCTURE - CONCRETE				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Conc)	Full SuperStr Replacement	\$94.53	50	Rating = 8
Rehab (Supr - Conc)	Replace Structural Component	\$47.27	15	+ 2
Repair (Supr - Conc)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	\$189.06	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 1
SUBSTRUCTURE - STRUCTURAL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Substr)	Full SubStr Replacement	\$94.53	75	Rating = 8
Rehab (Substr)	Replace Structural Component	\$47.27	50	+ 2
Repair (Substr)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
SUBSTRUCTURE - SCOUR				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Rehab (Substr - Scour)	Add scour protection slabs	\$47.27	50	+ 2
Repair (Substr - Scour)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	\$189.06	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 1

LEROUX WASH BR EB (#1772) / I-40 / MP 284.31																																													
Option 1 - Replace Bridge Now																																													
Bridge Deck Area =		19492 SF																																											
Widen Deck Area =		19492 SF																																											
Year Built =		1977																																											
Exp Service Life =		75 YR																																											
<div>Notes:</div> <div>1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.</div> <div>2. When superstructure replacement is selected, deck replacement should be selected as well.</div> <div>3. Deck Rehab does not account for any deck widening during replacement.</div> <div>4. Widened deck area applies to bridge replacement only.</div> <div>5. Repair deck (after bridge replace) should provide a deck deterioration of 1 point every 20 years.</div>																																													
<table><tr><th rowspan="2">Item</th><th colspan="3">Deterioration Line Equation</th><th rowspan="2">Year Drop</th></tr><tr><th>Slope =</th><th>Days</th><th>Years</th></tr><tr><td>Substr</td><td>y =</td><td>-0.000435x</td><td>-0.159x</td><td>6.31</td></tr><tr><td>Superstr</td><td>y =</td><td>-0.000411x</td><td>-0.150x</td><td>6.67</td></tr><tr><td>Deck</td><td>y =</td><td>-0.000137x</td><td>-0.050x</td><td>20.00</td></tr></table>																							Item	Deterioration Line Equation			Year Drop	Slope =	Days	Years	Substr	y =	-0.000435x	-0.159x	6.31	Superstr	y =	-0.000411x	-0.150x	6.67	Deck	y =	-0.000137x	-0.050x	20.00
Item	Deterioration Line Equation			Year Drop																																									
	Slope =	Days	Years																																										
Substr	y =	-0.000435x	-0.159x	6.31																																									
Superstr	y =	-0.000411x	-0.150x	6.67																																									
Deck	y =	-0.000137x	-0.050x	20.00																																									
Substructure							Superstructure							Deck							Summary																								
Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 \$ raw costs)	Present Value at 3%	Present Value at 7%																							
0	2015	4	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.				5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.				7	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.																																
1	2016	4					5					7																																	
2	2017	4					5					7																																	
3	2018	4					5					7																																	
4	2019	4					5					7																																	
5	2020	4					5					7																																	
6	2021	8	Replace (Bridge)	\$189.06	\$3,685,157.52	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	\$3,685,157.52	\$3,086,261.41	\$2,455,576.06																						
7	2022	8	Repair (After Bridge Replace)					8	Repair (After Bridge Replace)					8	Repair (After Bridge Replace)					8																									
8	2023	8						8						8						8																									
9	2024	8						8						8						8																									
10	2025	8						8						8						8																									
11	2026	8						8						8						8																									
12	2027	8						8						8						8																									
13	2028	8						8						8						8																									
14	2029	8						8						8						8																									
15	2030	8						8						8						8																									
16	2031	7						7						7						7																									
17	2032	7						7						7						7																									
18	2033	7						7						7						7																									
19	2034	7						7						7						7																									
20	2035	7						7						7						7																									
21	2036	7						7						7						7																									
22	2037	7						7						7						7																									
23	2038	7						7						7						7																									
24	2039	7						7						7						7																									
25	2040	6						6						6						6																									
26	2041	7	Repair (After Bridge Replace)	\$3.00	\$58,476.00	20	+ 1	7	Repair (After Bridge Replace)	\$3.00	\$58,476.00	20	+ 1	7	Repair (After Bridge Replace)	\$3.00	\$58,476.00	20	+ 0	7	\$175,428.00	\$81,345.04	\$30,207.91																						
27	2042	7						7						7						7																									
28	2043	7						7						7						7																									
29	2044	7						7						7						7																									
30	2045	7						7						7						7																									
31	2046	7						7						7						7																									
32	2047	7						7						7						7																									
33	2048	7						7						7						7																									
34	2049	7						7						7						7																									
35	2050	7						7						7						7																									
36	2051	6						6						6						6																									
37	2052	6						6						6						6																									
38	2053	6						6						6						6																									
39	2054	6						6						6						6																									
40	2055	6						6						6						6																									
41	2056	6						6						6						6																									
42	2057	6						6						6						6																									
43	2058	6						6						6						6																									
44	2059	6						6						6						6																									
45	2060	5	Repair (After Bridge Replace)	\$3.00	\$58,476.00	20	+ 1	5	Repair (After Bridge Replace)	\$3.00	\$58,476.00	20	+ 1	5	Repair (After Bridge Replace)	\$3.00	\$58,476.00	20	+ 0	5	\$175,428.00	\$45,038.78	\$7,806.30																						
46	2061	6						6						6						6																									
47	2062	6						6						6						6																									
48	2063	6						6						6						6																									
49	2064	6						6						6						6																									
50	2065	6						6																																					
51	2066	6						6						6						6																									
52	2067	6						6						6						6																									
53	2068	6						6						6						6																									
54	2069	6						6						6						6																									
55	2070	5						5						5						5																									
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58	2073	5	5	5	5																																								
59	2074	5	5	5	5																																								
60	2075	5	5	5	5																																								
61	2076	5	5	5	5																																								
62	2077	5	5	5	5																																								
63	2078	5	5	5	5																																								
64	2079	5	5	5	5																																								
65	2080	5	5	5	5																																								
Total Cost =																			\$4,036,013.52	\$3,212,645.22	\$2,493,590.27																								
Average Rating =																			6.45																										
End Rating =																			5																										
Comments:																																													

September 2016 Appendix B - 26 I-40 East

September 2016

Appendix B - 27

I-40 East

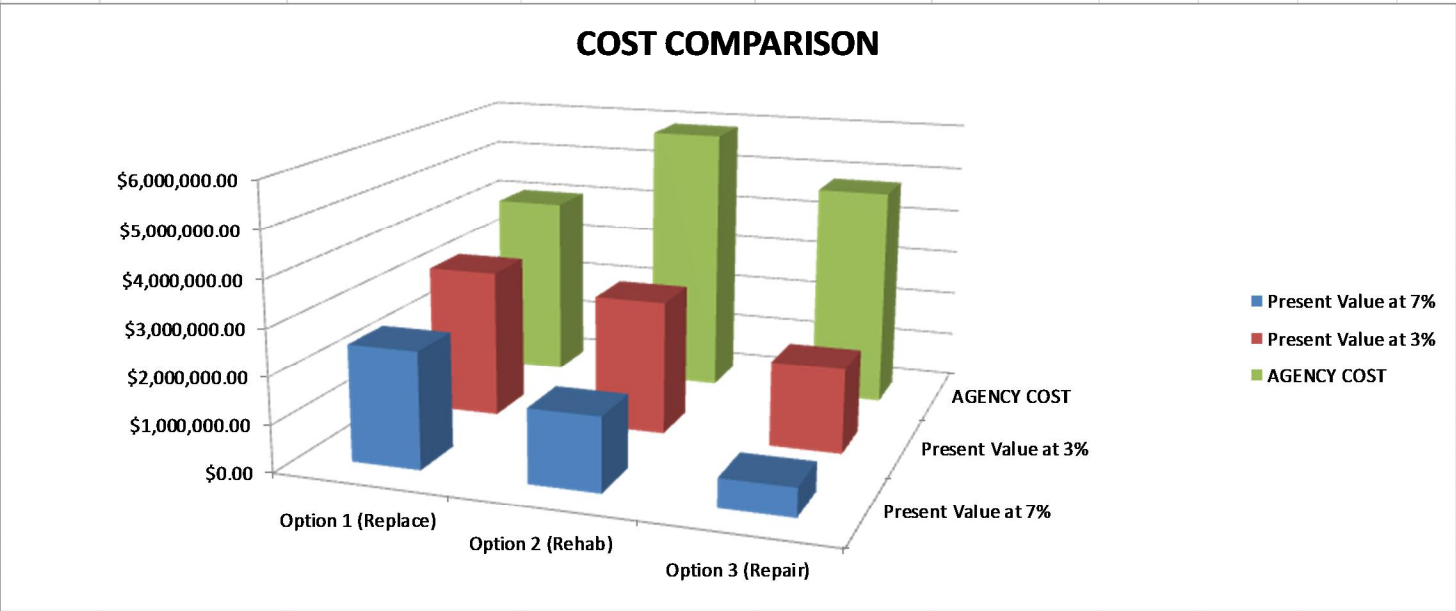
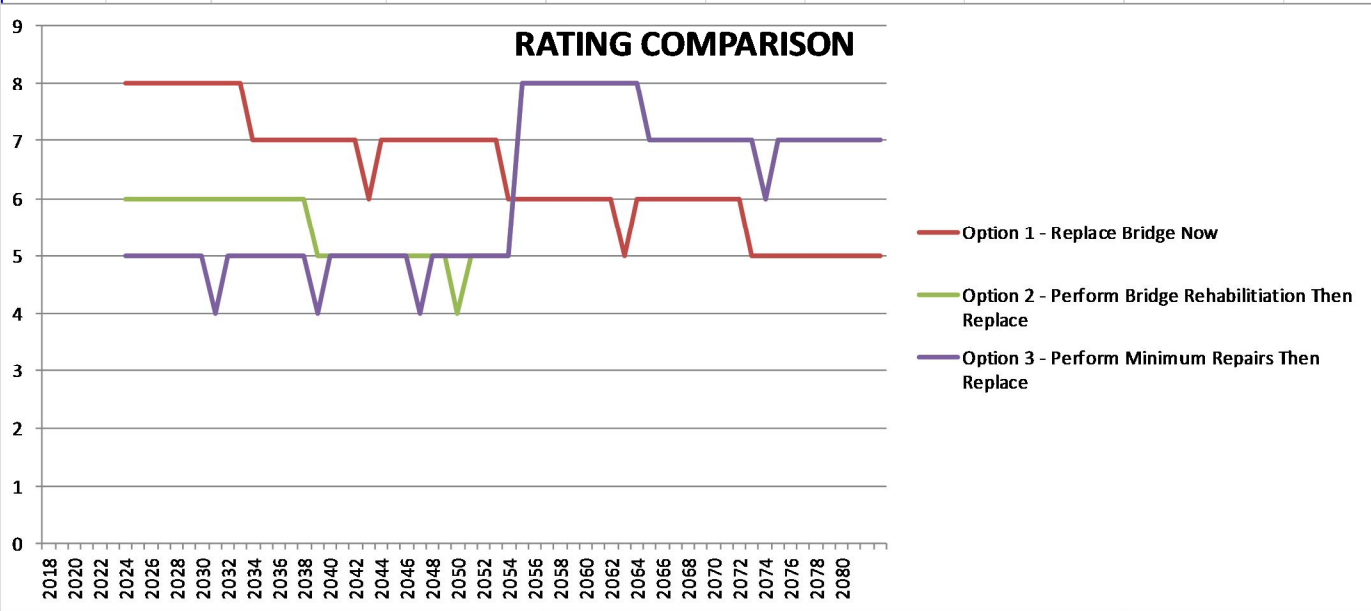
LEROUX WASH BR EB (#1772) / I-40 / MP 284.31

COST COMPARISON Present Value 2015 Dollars - Raw Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$ 4,036,013.52	\$3,212,645.22	\$2,493,590.27
Option 2 (Rehab)	\$ 5,878,592.28	\$2,890,626.20	\$1,563,218.81
Option 3 (Repair)	\$ 4,796,201.52	\$1,821,096.95	\$615,755.78

Bridge Ratings Per Option		
OPTION	AVG RATING	END RATING
Option 1 (Replace)	6.45	5
Option 2 (Rehab)	6.35	7
Option 3 (Repair)	6.07	7

Comparison to Replacement			
Option	Agency Cost	3%	7%
2 (Rehab)	68.66%	111.14%	159.52%
3 (Repair)	84.15%	176.41%	404.96%

COST COMPARISON Present Value 2015 Dollars - Fully Loaded Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$8,879,230	\$7,067,819	\$5,485,899
Option 2 (Rehab)	\$12,932,903	\$6,359,378	\$3,439,081
Option 3 (Repair)	\$10,551,643	\$4,006,413	\$1,354,663



Bridge History (Inspections/As-builts)											
Description							Category			Year	
Original construction I-40-4(30).										1977	
I-040-D-NFA provided scour protection.							Rehab (Substr - Scour)			2007	
I-040-D(223)T provided a new deck overlay.							Replace (Deck)			2015	
Cracks noted in superstructure and substructure is in poor condition. Consider rehab of both for option 2. Deck is already done (therefore 20 years).											

Replace / Rehab / Repair Information				
BRIDGE DECK				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Deck)	Full Deck Replacement	\$94.53	25	Rating = 8
Rehab (Deck Concrete Overlay)	Overlay (Concrete)	\$10.00	15	+ 2
Rehab (Deck Epoxy Overlay)	Overlay (Epoxy)	\$5.00	10	+ 1
Repair (Deck)	Patch Spalls / Seal Cracks	\$3.00	See Deterioration Slope	+ 0
Replace (Bridge)	Full Bridge Replacement	\$189.06	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 0
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 0
SUPERSTRUCTURE - STEEL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Stl)	Full SuperStr Replacement	\$94.53	50	Rating = 8
Rehab (Supr - Stl)	Weld New Structural Components	\$47.27	15	+ 2
Repair (Supr - Stl)	Weld Repair / Crack Relief	\$5.00	See Deterioration Slope	+ 1
SUPERSTRUCTURE - CONCRETE				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Conc)	Full SuperStr Replacement	\$94.53	50	Rating = 8
Rehab (Supr - Conc)	Replace Structural Component	\$47.27	15	+ 2
Repair (Supr - Conc)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	\$189.06	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 1
SUBSTRUCTURE - STRUCTURAL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Substr)	Full SubStr Replacement	\$94.53	75	Rating = 8
Rehab (Substr)	Replace Structural Component	\$47.27	50	+ 2
Repair (Substr)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
SUBSTRUCTURE - SCOUR				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Rehab (Substr - Scour)	Add scour protection slabs	\$47.27	50	+ 2
Repair (Substr - Scour)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	\$189.06	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 1

September 2016 Appendix B - 33 I-40 East

LEROUX WASH BR WB (#1773) / I-40 / MP 284.31																										
Option 3 - Perform Minimum Repairs Then Replace																										
<div>Bridge Deck Area = 19492 SF</div> <div>Widen Deck Area = 19492 SF</div> <div>Year Built = 1977</div> <div>Exp Service Life = 75 YR</div>				<div>Notes:</div> <div>1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.</div> <div>2. When superstructure replacement is selected, deck replacement should be selected as well.</div> <div>3. Deck Rehab does not account for any deck widening during replacement.</div> <div>4. Widened deck area applies to bridge replacement only.</div> <div>5. Repair deck (after bridge replace) should provide a deck deterioration of 1 point every 20 years. Repair (Deck) should maintain deck rating for life of repair, if the rating would otherwise drop a point (i.e., if the rating would drop from a "5" to a "4", Repair Deck would maintain a "5" at that year.</div> <div>6. For other repair items, the "+" value rating should be applied to improve the bridge rating's value for that year.</div>										<div><div>Item</div><div>Deterioration Line Equation</div><div>Year Drop</div></div> <div><div>Substr</div><div>y = -0.000411x</div><div>-0.150x</div><div>6.67</div></div> <div><div>Superstr</div><div>y = -0.000411x</div><div>-0.150x</div><div>6.67</div></div> <div><div>Deck</div><div>y = -0.000137x</div><div>-0.050x</div><div>20.00</div></div>												
Substructure								Superstructure								Deck				Summary						
	Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 \$ raw costs)	Present Value at 3%	Present Value at 7%			
0	2015	4	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					6	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.											
1	2016	4		5	6																					
2	2017	4		5	6																					
3	2018	4		5	6																					
4	2019	4		5	6																					
5	2020	4					5						6													
6	2021	5	Repair (Substr)	\$5.00	\$97,460.00	7	+ 1	6	Repair (Supr - Conc)	\$5.00	\$97,460.00	7	+ 1	6						5	\$194,920.00	\$163,242.43	\$129,883.43			
7	2022	5					6						6	5												
8	2023	5					6						6	5												
9	2024	5					6						6	5												
10	2025	5					6						6	5												
11	2026	5					6						5	5												
12	2027	4					6						5	4												
13	2028	5	Repair (Substr)	\$5.00	\$97,460.00	7	+ 1	6					5	5		\$97,460.00	\$66,365.52	\$40,442.44								
14	2029	5					5						5	5												
15	2030	5					5						5	5												
16	2031	5					5						5	5												
17	2032	5					5						5	5												
18	2033	5					5						5	5												
19	2034	4					5						5	4												
20	2035	5	Repair (Substr)	\$5.00	\$97,460.00	7	+ 1	5	Replace (Supr - Conc)					5	Repair (Deck)					5	\$97,460.00	\$53,961.24	\$25,185.52			
21	2036	5					4							5		4	\$58,476.00	\$31,433.73	\$14,122.72							
22	2037	5					5	\$94.53		\$1,842,578.76	50	Rating = 8	5	5		\$1,842,578.76	\$961,628.04	\$415,894.28								
23	2038	5					5							5		5										
24	2039	5					5							5		5										
25	2040	5					5						5	5												
26	2041	4					5						5	4												
27	2042	5	Repair (Substr)	\$5.00	\$97,460.00	7	+ 1	5					5	5		\$97,460.00	\$43,875.43	\$15,684.27								
28	2043	5					4						5	4												
29	2044	5					5	Repair (Supr - Conc)	\$5.00	\$97,460.00	7	+ 1	5	5		\$97,460.00	\$41,356.80	\$13,699.25								
30	2045	5					5						5	5												
31	2046	5					5						5	5	Repair (Deck)	\$3.00	\$58,476.00	20	+ 0	5	\$58,476.00	\$23,389.65	\$7,179.27			
32	2047	5					5						5	5												
33	2048	5					5						5	5												
34	2049	4					5						5	4												
35	2050	5	Repair (Substr)	\$5.00	\$97,460.00	7	+ 1	4					5	4		\$97,460.00	\$34,635.67	\$9,128.39								
36	2051	5					5	Repair (Supr - Conc)	\$5.00	\$97,460.00	7	+ 1	5	5	\$97,460.00	\$33,626.86	\$8,531.21									
37	2052	8	Replace (Bridge)	\$189.06	\$3,685,157.52	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	\$3,685,157.52	\$1,234,464.89	\$301,478.46			
38	2053	8						8						8						8						
39	2054	8						8						8						8						
40	2055	8						8						8						8						
41	2056	8						8						8						8						
42	2057	8						8						8						8						
43	2058	8						8						8						8						
44	2059	8						8						8						8						
45	2060	8						8						8						8						
46	2061	8						8						8						8						
47	2062	7						7						7						7						
48	2063	7						7						7						7						
49	2064	7						7						7						7						
50	2065	7						7						7						7						
51	2066	7						7						7						7						
52	2067	7						7						7						7						
53	2068	7						7						7						7						
54	2069	7						7						7						7						
55	2070	7						7						7						7						
56	2071	6						6						6						6						
57	2072	7	Repair (After Bridge Replace)	\$3.00	\$58,476.00	20	+ 1	7	Repair (After Bridge Replace)	\$3.00	\$58,476.00	20	+ 1	7	Repair (After Bridge Replace)	\$3.00	\$58,476.00	20	+ 0	7	\$175,428.00	\$32,536.97	\$3,708.72			
58	2073	7						7						7						7						
59	2074	7						7						7						7						
60	2075	7						7						7						7						
61	2076	7						7						7						7						
62	2077	7						7						7						7						
63	2078	7						7						7						7						
64	2079	7						7						7						7						
65	2080	7						7						7						7						
Total Cost =																					\$6,599,796.28		\$2,720,517.21		\$984,937.95	
Average Rating =																					6.00					
End Rating =																					7					
Comments:																										

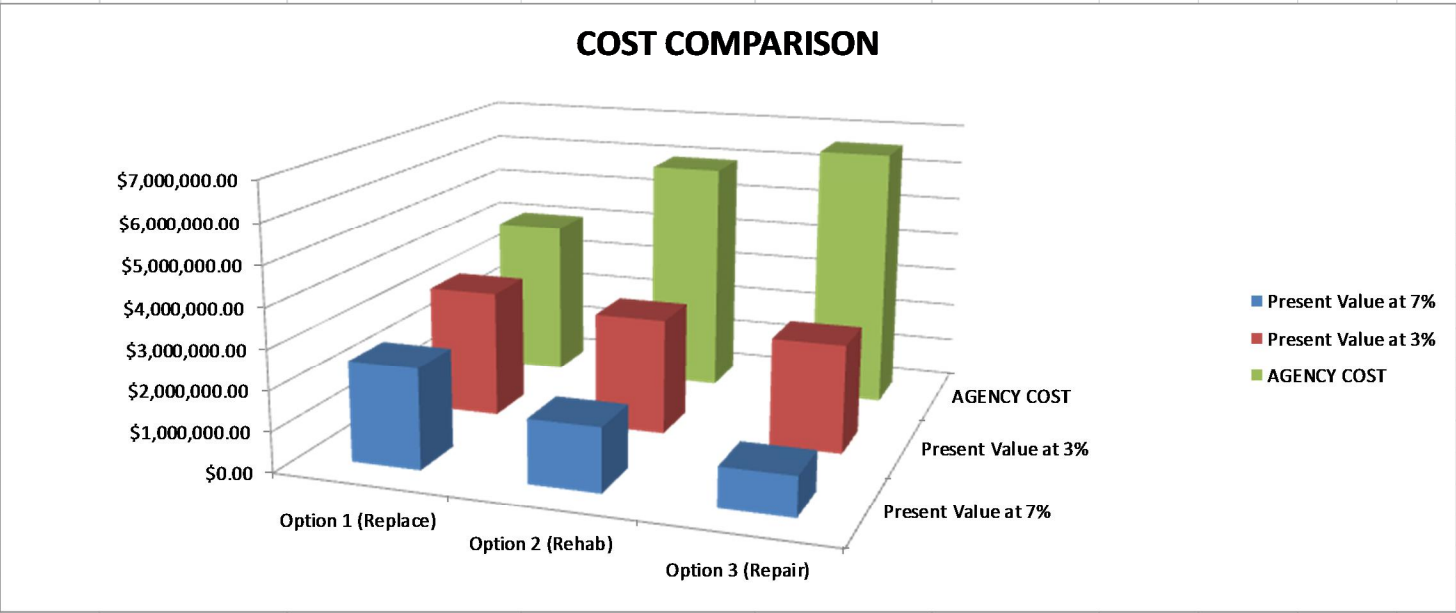
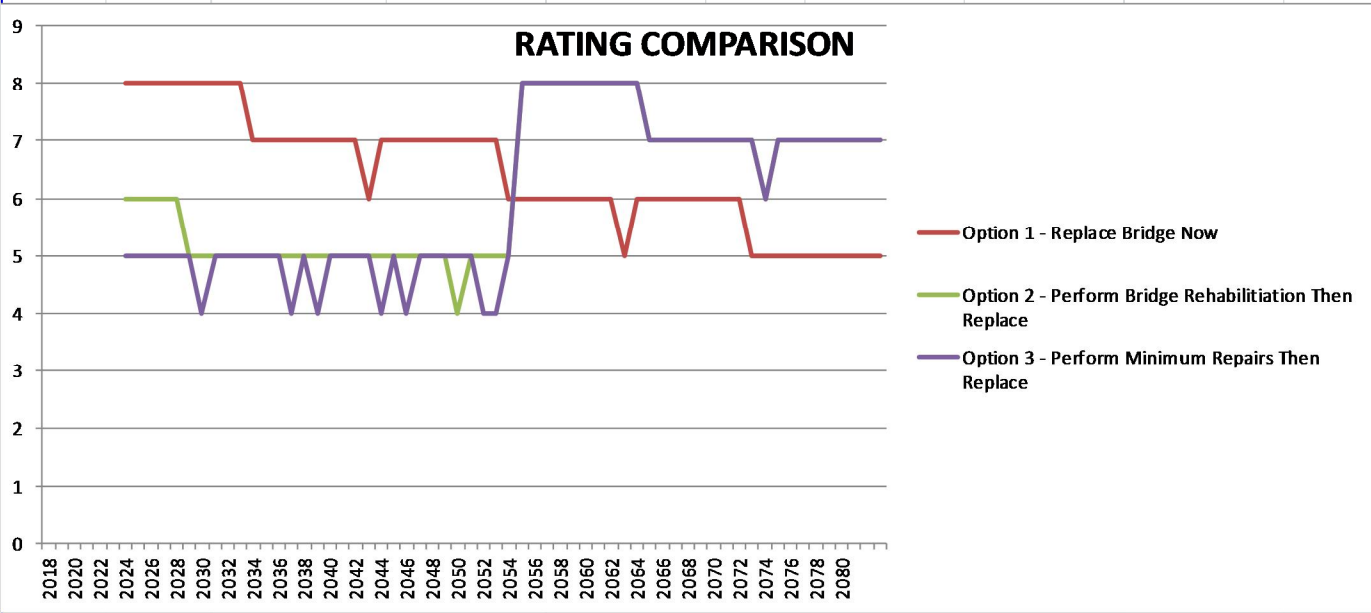
LEROUX WASH BR WB (#1773) / I-40 / MP 284.31

COST COMPARISON Present Value 2015 Dollars - Raw Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$ 4,036,013.52	\$3,212,645.22	\$2,493,590.27
Option 2 (Rehab)	\$ 5,937,068.28	\$2,917,521.11	\$1,573,746.65
Option 3 (Repair)	\$ 6,599,796.28	\$2,720,517.21	\$984,937.95

Comparison to Replacement			
Option	Agency Cost	3%	7%
2 (Rehab)	67.98%	110.12%	158.45%
3 (Repair)	61.15%	118.09%	253.17%

COST COMPARISON Present Value 2015 Dollars - Fully Loaded Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$8,879,230	\$7,067,819	\$5,485,899
Option 2 (Rehab)	\$13,061,550	\$6,418,546	\$3,462,243
Option 3 (Repair)	\$14,519,552	\$5,985,138	\$2,166,863

Bridge Ratings Per Option		
OPTION	AVG RATING	END RATING
Option 1 (Replace)	6.45	5
Option 2 (Rehab)	6.18	7
Option 3 (Repair)	6.00	7



E HOLBROOK TI OP WB (#1370) / I-40 / MP 289.80									
Bridge Information			Deterioration Slope						
Bridge Deck Area (A225)	10934 SF		Item	Deterioration Line Equation			Year		
Year Built (N27)	1969			Slope =	Days	Years	Drop		
Exp Service Life	75 YR		Substr	y =	-0.000195x	-0.071x	14.06		
Total Bridge Length (N49)	268 LF		Superstr	y =	-0.000419x	-0.153x	6.54		
Number of Spans (N45+N46)	3		Deck	y =	-0.000395x	-0.144x	6.94		
Skew Angle (N34)	59 DEG								
Average Elevation	5275 FT								
Max Pier Height	18 FT								
* Amount of Widening for Bridge	4 FT		*Input 0 if no widening. Input should include widening on both sides of bridge if applicable. **If scour critical rating is 3 or lower, Option 2 should consider the implementation of scour countermeasures.			Notes:			
Revised Deck Area (Bridge Replace)	12006 FT					1. Widening is intended only to correct lane and/or shoulder width deficiencies. It is not intended for adding traffic capacity (i.e. adding general purpose lanes).			
**Scour Critical Rating (N113)	N/A								
Cost Multipliers			L to # Span Multiplier				Skew Multiplier		
Elevation > 4000ft	5275	1.25	L/ # Span Ratio		Multiplier		Skew	Multiplier	
Pier Height > 30ft	18	1.00	=>100		1.00		<30	1.00	
Length to # span ratio	89.33	1.1	=>60		1.10		=>30	1.10	
Skew > 30degrees	59.00	1.10	<60		1.25				
Project Cost Multiplier	All Options	2.20							
Adjusted Bridge Replace Cost			Elevation Multiplier				Pier H Multiplier		
Base Bridge Replacement Cost (Per SF)	\$125.00		Elev	Multiplier			Pier H	Multiplier	
			<4000	1.00			<30	1.00	
Bridge Replacement Cost w/ Multipliers (Per SF)	\$189.06		=>4000	1.25			=>30	1.10	
						User input cell			
						Only manipulate cell value after consulting with team			

Bridge History (Inspections/As-builts)											
Description							Category			Year	
Original construction I-40-4(35).										1969	
Methacrylate deck seal performed under I-040-D(227)T. Therefore, option 2 will not consider deck rehab options.							Rehab (Deck Epoxy Overlay)			2015	
Superstructure steel had previously exhibited cracks as noted in inspection reports. Fatigue prone details also noted. Consider rehab in option 2.											
Substructure had rocker bearings recently replaced - assume repairs in option 2 only.											

Replace / Rehab / Repair Information				
BRIDGE DECK				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Deck)	Full Deck Replacement	\$94.53	25	Rating = 8
Rehab (Deck Concrete Overlay)	Overlay (Concrete)	\$10.00	15	+ 2
Rehab (Deck Epoxy Overlay)	Overlay (Epoxy)	\$5.00	10	+ 1
Repair (Deck)	Patch Spalls / Seal Cracks	\$3.00	See Deterioration Slope	+ 0
Replace (Bridge)	Full Bridge Replacement	\$189.06	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 0
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 0
SUPERSTRUCTURE - STEEL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Stl)	Full SuperStr Replacement	\$94.53	50	Rating = 8
Rehab (Supr - Stl)	Weld New Structural Components	\$47.27	15	+ 2
Repair (Supr - Stl)	Weld Repair / Crack Relief	\$5.00	See Deterioration Slope	+ 1
SUPERSTRUCTURE - CONCRETE				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Conc)	Full SuperStr Replacement	\$94.53	50	Rating = 8
Rehab (Supr - Conc)	Replace Structural Component	\$47.27	15	+ 2
Repair (Supr - Conc)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	\$189.06	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 1
SUBSTRUCTURE - STRUCTURAL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Substr)	Full SubStr Replacement	\$94.53	75	Rating = 8
Rehab (Substr)	Replace Structural Component	\$47.27	50	+ 2
Repair (Substr)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
SUBSTRUCTURE - SCOUR				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Rehab (Substr - Scour)	Add scour protection slabs	\$47.27	50	+ 2
Repair (Substr - Scour)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	\$189.06	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 1

E HOLBROOK TI OP WB (#1370) / I-40 / MP 289.80																							
Option 2 - Perform Bridge Rehabilitation Then Replace																							
Bridge Deck Area =		10934 SF																					
Widen Deck Area =		12006 SF																					
Year Built =		1969																					
Exp Service Life =		75 YR																					
<div>Notes:</div> <div>1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.</div> <div>2. When superstructure replacement is selected, deck replacement should be selected as well.</div> <div>3. Deck Rehab does not account for any deck widening during replacement.</div> <div>4. Widened deck area applies to bridge replacement only.</div> <div>5. Repair deck (after bridge replace) should provide a deck deterioration of 1 point every 20 years. Repair (Deck) should maintain deck rating for life of repair, if the rating would otherwise drop a point (i.e., if the rating would drop from a "5" to a "4", Repair Deck would maintain a "5" at that year.)</div> <div>6. For other repair items, the "+" value rating should be applied to improve the bridge rating's value for that year.</div>																							
<div><div><div>Substructure</div><div>Superstructure</div><div>Deck</div><div>Summary</div></div></div>																							
	Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 \$ raw costs)	Present Value at 3%	Present Value at 7%
0	2015	5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					4	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.								
1	2016	5		4	5																		
2	2017	5		4	5																		
3	2018	5		4	5																		
4	2019	5		4	5																		
5	2020	5					4						5										
6	2021	5	Repair (Substr)					6	Rehab (Supr - Stl)	\$47.27	\$516,795.51	15	+ 2	5	Repair (Deck)					5	\$516,795.51	\$432,808.10	\$344,362.67
7	2022	5		6	5																		
8	2023	5		6	5																		
9	2024	5		6	5																		
10	2025	5		6	5																		
11	2026	5		6	5																		
12	2027	5		6	5																		
13	2028	5		6	5																		
14	2029	4		5	5																		
15	2030	5						5						5						5	\$54,670.00	\$35,090.59	\$19,814.92
16	2031	5					5						5										
17	2032	5					5						5										
18	2033	5					5						5										
19	2034	5					5						5										
20	2035	5					5						5										
21	2036	5					5						5										
22	2037	5					4						5										
23	2038	5					5	Repair (After Rehab)	\$3.00	\$32,802.00	10	+ 1	5					5	\$32,802.00	\$17,119.12	\$7,403.84		
24	2039	5					5						5							\$32,802.00	\$16,620.50	\$6,919.48	
25	2040	5					5						5										
26	2041	5					5						5										
27	2042	5					5						5										
28	2043	5					5						5										
29	2044	8	Replace (Bridge)	\$189.06	\$2,269,854.36	75	Rating = 8		Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	\$2,269,854.36	\$963,204.44	\$319,057.12
30	2045	8						8						8									
31	2046	8						8						8									
32	2047	8						8						8									
33	2048	8						8						8									
34	2049	8						8						8									
35	2050	8						8						8									
36	2051	8						8						8									
37	2052	8						8						8									
38	2053	8						8						8									
39	2054	7						7						7									
40	2055	7						7						7									
41	2056	7						7						7									
42	2057	7						7						7									
43	2058	7						7						7									
44	2059	7						7						7									
45	2060	7						7						7									
46	2061	7						7						7									
47	2062	7						7						7									
48	2063	6						6						6									
49	2064	7	Repair (After Bridge Replace)	\$3.00	\$36,018.00	20	+ 1	7	Repair (After Bridge Replace)	\$3.00	\$36,018.00	20	+ 1	7	Repair (After Bridge Replace)	\$3.00	\$36,018.00	20	+ 0	7	\$108,054.00	\$25,387.32	\$3,924.96
50	2065	7						7						7									
51	2066	7						7						7									
52	2067	7						7						7									
53	2068	7						7						7									
54	2069	7						7						7									
55	2070	7						7						7									
56	2071	7						7						7									
57	2072	7						7						7									
58	2073	7						7						7									
59	2074	6						6						6									
60	2075	6						6						6									
61	2076	6						6						6									
62	2077	6						6						6									
63	2078	6						6						6									
64	2079	6						6						6									
65	2080	6						6						6									
Total Cost =																					\$3,047,779.87	\$1,512,566.64	\$715,094.66
Average Rating =																					6.23		
End Rating =																					6		
Comments:																							

E HOLBROOK TI OP WB (#1370) / I-40 / MP 289.80																								
Option 3 - Perform Minimum Repairs Then Replace																								
Bridge Deck Area =		10934 SF																						
Widen Deck Area =		12006 SF																						
Year Built =		1969																						
Exp Service Life =		75 YR																						
<div>Notes:</div> <div>1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.</div> <div>2. When superstructure replacement is selected, deck replacement should be selected as well.</div> <div>3. Deck Rehab does not account for any deck widening during replacement.</div> <div>4. Widened deck area applies to bridge replacement only.</div> <div>5. Repair deck (after bridge replace) should provide a deck deterioration of 1 point every 20 years. Repair (Deck) should maintain deck rating for life of repair, if the rating would otherwise drop a point (i.e., if the rating would drop from a "5" to a "4", Repair Deck would maintain a "5" at that year.</div> <div>6. For other repair items, the "+" value rating should be applied to improve the bridge rating's value for that year.</div>																								
<div><div><div>Item</div><div>Deterioration Line Equation</div><div>Year Drop</div></div><div><div>Slope =</div><div>Days</div><div>Years</div></div><div><div>Substr</div><div>y = -0.000195x</div><div>-0.071x</div><div>14.06</div></div><div><div>Superstr</div><div>y = -0.000419x</div><div>-0.153x</div><div>6.54</div></div><div><div>Deck</div><div>y = -0.000395x</div><div>-0.144x</div><div>6.94</div></div></div>																								
Substructure							Superstructure							Deck							Summary			
Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 \$ raw costs)	Present Value at 3%	Present Value at 7%		
0	2015	5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.				4	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.				5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.											
1	2016	5					4					5									5			
2	2017	5					4					5									5			
3	2018	5					4					5									5			
4	2019	5					4					5									5			
5	2020	5	Repair (Substr)				4	Repair (Supr - Stl)				5	Repair (Deck)				5	\$54,670.00				\$45,785.26	\$36,428.93	
6	2021	5					5					5					5							
7	2022	5					5					5					5							
8	2023	5					5					5					5							
9	2024	5					5					5					5							
10	2025	5					5					5					5							
11	2026	5					5					5					5							
12	2027	5					5					5					5							
13	2028	5					4					5					4							
14	2029	4					5					5					4							
15	2030	5					5					5					5							
16	2031	5					5					5					5							
17	2032	5					5					5					5							
18	2033	5					5					5					5							
19	2034	5					5					5					5							
20	2035	5					5					5					5							
21	2036	5					4					5					4							
22	2037	5					5					5					5							
23	2038	5					5					5					5							
24	2039	5					5					5					5							
25	2040	5					5					5					5							
26	2041	5					5					5					5							
27	2042	5					5					5					5							
28	2043	5					5					5					5							
29	2044	8					8					8					8							
30	2045	8					8					8					8							
31	2046	8					8					8					8							
32	2047	8					8					8					8							
33	2048	8					8					8					8							
34	2049	8					8					8					8							
35	2050	8					8					8					8							
36	2051	8					8					8					8							
37	2052	8					8					8					8							
38	2053	8					8					8					8							
39	2054	7					7					7					7							
40	2055	7					7					7					7							
41	2056	7					7					7					7							
42	2057	7					7					7					7							
43	2058	7					7					7					7							
44	2059	7					7					7					7							
45	2060	7					7					7					7							
46	2061	7					7					7					7							
47	2062	7					7					7					7							
48	2063	6					6					6					6							
49	2064	7					7					7					7							
50	2065	7					7					7					7							
51	2066	7					7					7					7							
52	2067	7					7					7					7							
53	2068	7					7					7					7							
54	2069	7					7					7					7							
55	2070	7					7					7					7							
56	2071	7					7					7					7							
57	2072	7					7					7					7							
58	2073	7					7					7	7											
59	2074	6	6	6	6																			
60	2075	6	6	6	6																			
61	2076	6	6	6	6																			
62	2077	6	6	6	6																			
63	2078	6	6	6	6																			
64	2079	6	6	6	6																			
65	2080	6	6	6	6																			
																			Total Cost =	\$2,662,192.36	\$1,173,598.47	\$433,783.15		
																			Average Rating =	6.22				
																			End Rating =	6				
Comments:																								

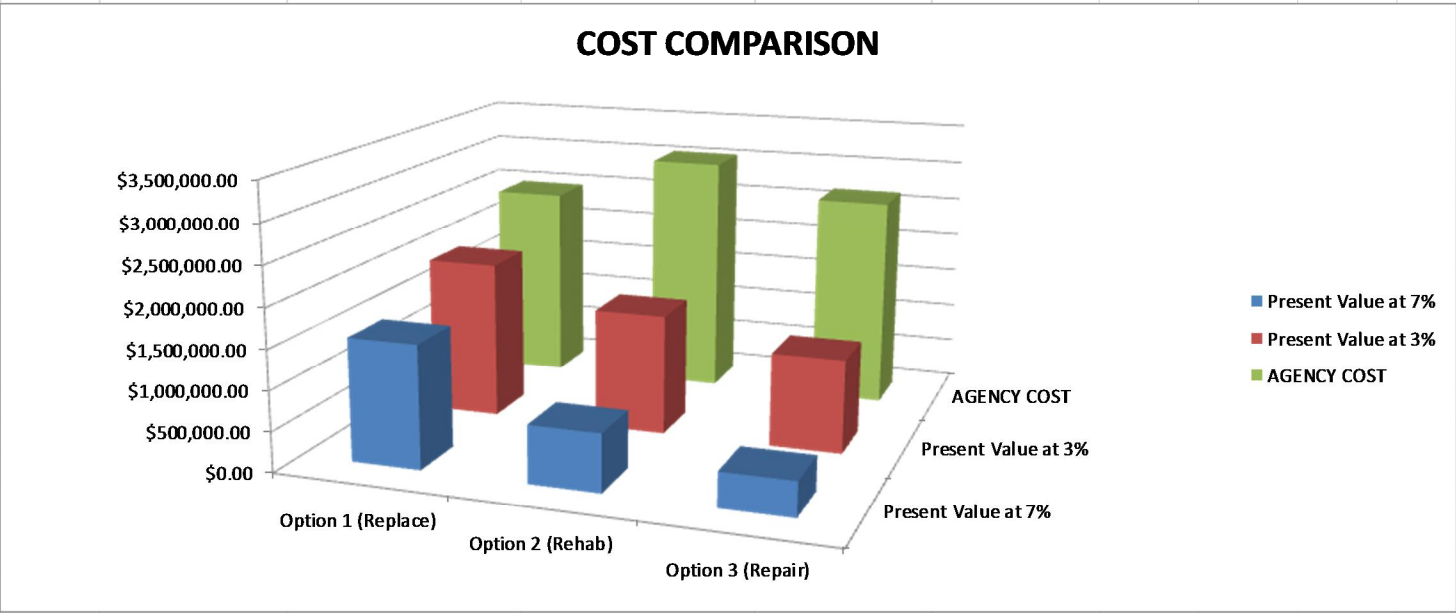
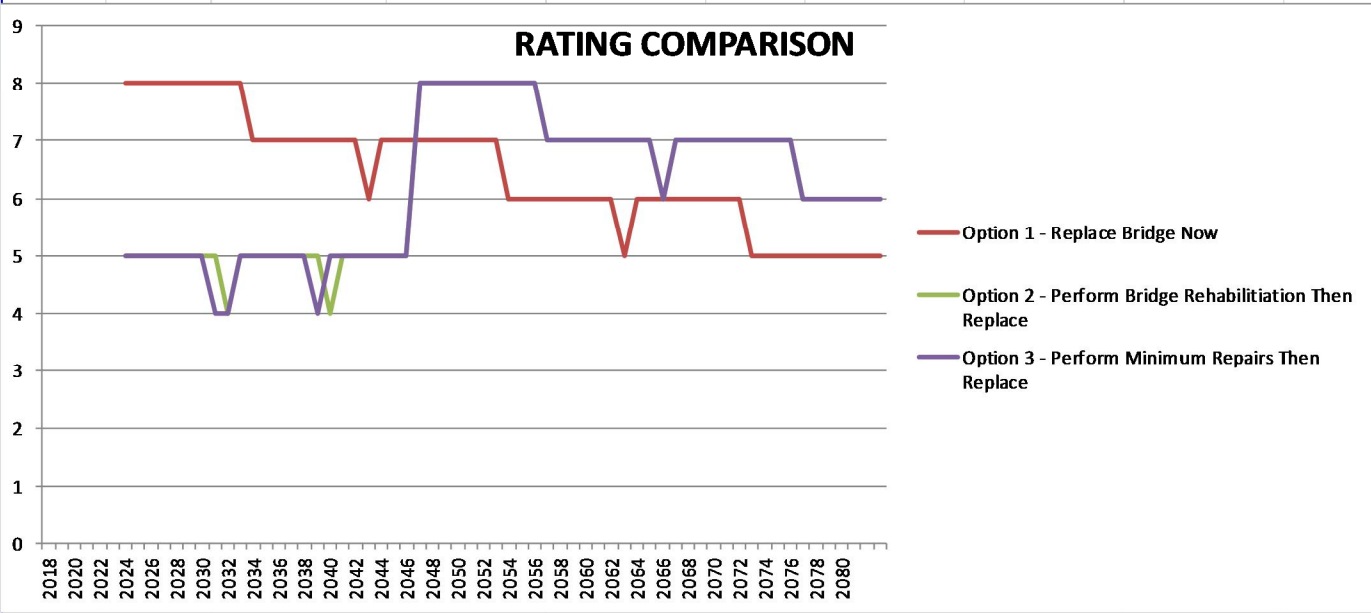
E HOLBROOK TI OP WB (#1370) / I-40 / MP 289.80

COST COMPARISON Present Value 2015 Dollars - Raw Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$ 2,485,962.36	\$1,978,812.77	\$1,535,914.46
Option 2 (Rehab)	\$ 3,047,779.87	\$1,512,566.64	\$715,094.66
Option 3 (Repair)	\$ 2,662,192.36	\$1,173,598.47	\$433,783.15

Comparison to Replacement			
Option	Agency Cost	3%	7%
2 (Rehab)	81.57%	130.82%	214.78%
3 (Repair)	93.38%	168.61%	354.07%

COST COMPARISON Present Value 2015 Dollars - Fully Loaded Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$5,469,117	\$4,353,388	\$3,379,012
Option 2 (Rehab)	\$6,705,116	\$3,327,647	\$1,573,208
Option 3 (Repair)	\$5,856,823	\$2,581,917	\$954,323

Bridge Ratings Per Option		
OPTION	AVG RATING	END RATING
Option 1 (Replace)	6.45	5
Option 2 (Rehab)	6.23	6
Option 3 (Repair)	6.22	6



Bridge History (Inspections/As-builts)											
Description							Category			Year	
Original construction I-40-4(35).										1969	
Methacrylate deck seal performed under I-040-D(227)T. Therefore, option 2 will not consider deck rehab options.							Rehab (Deck Epoxy Overlay)			2015	
Superstructure steel had previously exhibited cracks as noted in inspection reports. Fatigue prone details also noted. Consider rehab in option 2.											
Substructure had rocker bearings recently replaced - assume repairs in option 2 only.											

Replace / Rehab / Repair Information				
BRIDGE DECK				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Deck)	Full Deck Replacement	\$94.53	25	Rating = 8
Rehab (Deck Concrete Overlay)	Overlay (Concrete)	\$10.00	15	+ 2
Rehab (Deck Epoxy Overlay)	Overlay (Epoxy)	\$5.00	10	+ 1
Repair (Deck)	Patch Spalls / Seal Cracks	\$3.00	See Deterioration Slope	+ 0
Replace (Bridge)	Full Bridge Replacement	\$189.06	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 0
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 0
SUPERSTRUCTURE - STEEL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Stl)	Full SuperStr Replacement	\$94.53	50	Rating = 8
Rehab (Supr - Stl)	Weld New Structural Components	\$47.27	15	+ 2
Repair (Supr - Stl)	Weld Repair / Crack Relief	\$5.00	See Deterioration Slope	+ 1
SUPERSTRUCTURE - CONCRETE				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Conc)	Full SuperStr Replacement	\$94.53	50	Rating = 8
Rehab (Supr - Conc)	Replace Structural Component	\$47.27	15	+ 2
Repair (Supr - Conc)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	\$189.06	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 1
SUBSTRUCTURE - STRUCTURAL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Substr)	Full SubStr Replacement	\$94.53	75	Rating = 8
Rehab (Substr)	Replace Structural Component	\$47.27	50	+ 2
Repair (Substr)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
SUBSTRUCTURE - SCOUR				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Rehab (Substr - Scour)	Add scour protection slabs	\$47.27	50	+ 2
Repair (Substr - Scour)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	\$189.06	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 1

E HOLBROOK TI OP EB (#1369) / I-40 / MP 289.80																											
Option 2 - Perform Bridge Rehabilitation Then Replace																											
Bridge Deck Area = 10934 SF				<div>Notes:</div> <div>1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.</div> <div>2. When superstructure replacement is selected, deck replacement should be selected as well.</div> <div>3. Deck Rehab does not account for any deck widening during replacement.</div> <div>4. Widened deck area applies to bridge replacement only.</div> <div>5. Repair deck (after bridge replce) should provide a deck deterioration of 1 point every 20 years. Repair (Deck) should maintain deck rating for life of repair, if the rating would otherwise drop a point (i.e., if the rating would drop from a "5" to a "4", Repair Deck would maintain a "5" at that year.)</div> <div>6. For other repair items, the "+" value rating should be applied to improve the bridge rating's value for that year.</div>															Item				Deterioration Line Equation			Year Drop	
Widen Deck Area = 12006 SF																			Slope =		Days		Years				
Year Built = 1969																			y =		-0.000262x		-0.096x		10.45		
Exp Service Life = 75 YR																			y =		-0.000533x		-0.194x		5.15		
						y =		-0.000507x		-0.185x		5.40															
Substructure								Superstructure								Deck								Summary			
	Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 \$ raw costs)	Present Value at 3%	Present Value at 7%				
0	2015	5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					4	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					6	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.												
1	2016	5						4						6													
2	2017	5						4						6													
3	2018	5						4						6													
4	2019	5						4						6													
5	2020	5						4						6													
6	2021	5	Repair (Substr)					6	Rehab (Supr - Stl)	\$47.27	\$516,795.51	15	+ 2	5	Repair (Deck)						5	\$516,795.51	\$432,808.10	\$344,362.67			
7	2022	5						6						5							5						
8	2023	5						6						5							5						
9	2024	5						6						5							5						
10	2025	5						6						5		\$3.00	\$32,802.00	5	+ 0	5	\$32,802.00	\$24,407.77	\$16,674.87				
11	2026	5						6						5							5						
12	2027	5						6						5							5						
13	2028	5						6						5							5						
14	2029	5						5						5							5						
15	2030	5						5						5							5						
16	2031	4	Repair (Substr)	\$5.00	\$54,670.00	10	+ 1	5	Repair (After Rehab)	\$3.00	\$32,802.00	10	+ 1	5	Repair (Deck)	\$3.00	\$32,802.00	5	+ 0	4	\$32,802.00	\$20,441.12	\$11,111.17				
17	2032	5						5						5							5	\$54,670.00	\$33,076.25	\$17,307.12			
18	2033	5						5						5							5						
19	2034	5						5						5							5						
20	2035	5						5						5							5						
21	2036	5	Repair (Substr)					5	Repair (After Rehab)					5	Repair (Deck)	\$3.00	\$32,802.00	5	+ 0	5	\$32,802.00	\$17,632.69	\$7,922.11				
22	2037	5						4						5							4						
23	2038	5						5						5							5	\$32,802.00	\$16,620.50	\$6,919.48			
24	2039	5						5						5							5						
25	2040	5						5						5							5						
26	2041	4		Repair (Substr)	\$5.00	\$54,670.00	10	+ 1		5	Replace (Bridge)						5	Repair (Deck)	\$3.00	\$32,802.00	5	+ 0	4	\$32,802.00	\$15,210.11	\$5,648.36	
27	2042	5								5							5							5	\$54,670.00	\$24,611.84	\$8,798.06
28	2043	5								5							5							5			
29	2044	8								8							8							8	\$2,269,854.36	\$963,204.44	\$319,057.12
30	2045	8								8							8							8			
31	2046	8	Repair (After Bridge Replace)					8	Repair (After Bridge Replace)					8	Replace (Bridge)					8							
32	2047	8						8						8							8						
33	2048	8						8						8							8						
34	2049	8						8						8							8						
35	2050	8						8						8							8						
36	2051	8						8						8							8						
37	2052	8						8						8							8						
38	2053	8						8						8							8						
39	2054	7						7						7							7						
40	2055	7						7						7							7						
41	2056	7	Repair (After Bridge Replace)					7	Repair (After Bridge Replace)					7	Replace (Bridge)					7							
42	2057	7						7						7							7						
43	2058	7						7						7							7						
44	2059	7						7						7							7						
45	2060	7						7						7							7						
46	2061	7						7						7							7						
47	2062	7						7						7							7						
48	2063	6		Repair (After Bridge Replace)						6	Repair (After Bridge Replace)						6	Replace (Bridge)					6				
49	2064	7								7							7							7	\$108,054.00	\$25,387.32	\$3,924.96
50	2065	7								7							7							7			
51	2066	7						7						7							7						
52	2067	7						7						7							7						
53	2068	7						7						7							7						
54	2069	7						7						7							7						
55	2070	7						7						7							7						
56	2071	7						7						7							7						
57	2072	7						7						7							7						
58	2073	7	Repair (After Bridge Replace)					7	Repair (After Bridge Replace)					7	Replace (Bridge)					7							
59	2074	6						6						6							6						
60	2075	6						6						6							6						
61	2076	6						6						6							6						
62	2077	6						6						6							6						
63	2078	6						6						6							6						
64	2079	6						6						6							6						
65	2080	6						6						6							6						
Total Cost =																					\$3,168,053.87	\$1,573,400.15	\$741,725.93				
Average Rating =																					6.22						
End Rating =																					6						
Comments:																											

E HOLBROOK TI OP EB (#1369) / I-40 / MP 289.80																															
Option 3 - Perform Minimum Repairs Then Replace																															
Bridge Deck Area =		10934 SF																													
Widen Deck Area =		12006 SF																													
Year Built =		1969																													
Exp Service Life =		75 YR																													
<div>Notes:</div> <div>1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.</div> <div>2. When superstructure replacement is selected, deck replacement should be selected as well.</div> <div>3. Deck Rehab does not account for any deck widening during replacement.</div> <div>4. Widened deck area applies to bridge replacement only.</div> <div>5. Repair deck (after bridge replace) should provide a deck deterioration of 1 point every 20 years. Repair (Deck) should maintain deck rating for life of repair, if the rating would otherwise drop a point (i.e., if the rating would drop from a "5" to a "4", Repair Deck would maintain a "5" at that year.</div> <div>6. For other repair items, the "+" value rating should be applied to improve the bridge rating's value for that year.</div>																															
<div><div><div>Item</div><div>Deterioration Line Equation</div><div>Year Drop</div></div><div><div>Substr</div><div>y = -0.000262x</div><div>-0.096x</div><div>10.45</div></div><div><div>Superstr</div><div>y = -0.000533x</div><div>-0.194x</div><div>5.15</div></div><div><div>Deck</div><div>y = -0.000507x</div><div>-0.185x</div><div>5.40</div></div></div>																															
Substructure							Superstructure							Deck							Summary										
Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 \$ raw costs)	Present Value at 3%	Present Value at 7%									
0	2015	5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.				4	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.				6	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.																		
1	2016	5					4					6																			
2	2017	5					4					6																			
3	2018	5					4					6																			
4	2019	5					4					6																			
5	2020	5					4						6																		
6	2021	5	Repair (Substr)	\$5.00	\$54,670.00	10	+ 1	5	Repair (Supr - Stl)	\$5.00	\$54,670.00	5	+ 1	5	Repair (Deck)	\$3.00	\$32,802.00	5	+ 0	5	\$54,670.00	\$45,785.26	\$36,428.93								
7	2022	5						5				5									5										
8	2023	5						5				5									5										
9	2024	5						5				5									5										
10	2025	5						4				5									5										
11	2026	5						5				5	Repair (Supr - Stl)	\$5.00						\$54,670.00	5	+ 1	5				4	\$32,802.00	\$24,407.77	\$16,674.87	
12	2027	5						5				5												5				5	\$54,670.00	\$39,494.77	\$25,973.32
13	2028	5						5				5												5				5			
14	2029	5						5				5												5				5			
15	2030	5										4												5				4			
16	2031	4	Repair (Substr)	\$5.00	\$54,670.00	10	+ 1	5	Repair (Supr - Stl)	\$5.00	\$54,670.00	5	+ 1	5	Repair (Deck)	\$3.00	\$32,802.00	5	+ 0	4	\$87,472.00	\$54,509.66	\$29,629.79								
17	2032	5						5				5				5				4	\$54,670.00	\$33,076.25	\$17,307.12								
18	2033	5						5				5				5				5											
19	2034	5						5				5				5				5											
20	2035	5						4				5				5				4											
21	2036	5	Repair (Substr)	\$5.00	\$54,670.00	10	+ 1	5	Repair (Supr - Stl)	\$5.00	\$54,670.00	5	+ 1	5	Repair (Deck)	\$3.00	\$32,802.00	5	+ 0	5	\$87,472.00	\$47,020.51	\$21,125.63								
22	2037	5						5				5				5				5											
23	2038	5						5				5				5				5											
24	2039	5						5				5				5				5											
25	2040	5						4				5				5				4											
26	2041	4						5				5	Repair (Supr - Stl)	\$5.00	\$54,670.00	5	+ 1	5	Repair (Deck)	\$3.00	\$32,802.00	5	+ 0	4	\$87,472.00	\$40,560.31	\$15,062.28				
27	2042	5						5				5							5				5	\$54,670.00	\$24,611.84	\$8,798.06					
28	2043	5						5				5							5				5								
29	2044	8						Replace (Bridge)	\$189.06	\$2,269,854.36	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	\$2,269,854.36	\$963,204.44	\$319,057.12			
30	2045	8											8				8				8				8						
31	2046	8	8				8									8				8											
32	2047	8	8				8									8				8											
33	2048	8	8				8									8				8											
34	2049	8	8				8									8				8											
35	2050	8	8				8									8				8											
36	2051	8	8				8									8				8											
37	2052	8	8				8									8				8											
38	2053	8	8				8									8				8											
39	2054	7	Repair (After Bridge Replace)	\$3.00	\$36,018.00	20	+ 1	7				Repair (After Bridge Replace)	\$3.00	\$36,018.00	20	+ 1	7	Repair (After Bridge Replace)	\$3.00	\$36,018.00	20	+ 0	7	\$108,054.00	\$25,387.32	\$3,924.96					
40	2055	7						7							7				7				7								
41	2056	7						7							7				7				7								
42	2057	7						7							7				7				7								
43	2058	7						7							7				7				7								
44	2059	7						7							7				7				7								
45	2060	7						7							7				7				7								
46	2061	7						7							7				7				7								
47	2062	7						7							7				7				7								
48	2063	6						6							6				6				6								
49	2064	7	Repair (After Bridge Replace)	\$3.00	\$36,018.00	20	+ 1	7	Repair (After Bridge Replace)	\$3.00	\$36,018.00	20	+ 1	7	Repair (After Bridge Replace)	\$3.00	\$36,018.00	20	+ 0	7	\$108,054.00	\$25,387.32	\$3,924.96								
50	2065	7						7				7				7				7											
51	2066	7						7				7				7				7											
52	2067	7						7				7				7				7											
53	2068	7						7				7				7				7											
54	2069	7						7				7				7				7											
55	2070	7						7				7				7				7											
56	2071	7						7				7				7				7											
57	2072	7						7				7				7				7											
58	2073	7						7				7				7				7											
59	2074	6	Repair (After Bridge Replace)	\$3.00	\$36,018.00	20	+ 1	6	Repair (After Bridge Replace)	\$3.00	\$36,018.00	20	+ 1	6	Repair (After Bridge Replace)	\$3.00	\$36,018.00	20	+ 0	6	\$108,054.00	\$25,387.32	\$3,924.96								
60	2075	6						6				6				6				6											
61	2076	6						6				6				6				6											
62	2077	6						6				6				6				6											
63	2078	6						6				6				6				6											
64	2079	6						6				6				6				6											
65	2080	6						6				6				6				6											
<div>Total Cost = \$2,891,806.36</div> <div>Present Value at 3% = \$1,298,058.12</div> <div>Present Value at 7% = \$493,982.10</div>																															
<div>Average Rating = 6.17</div> <div>End Rating = 6</div>																															
Comments:																															

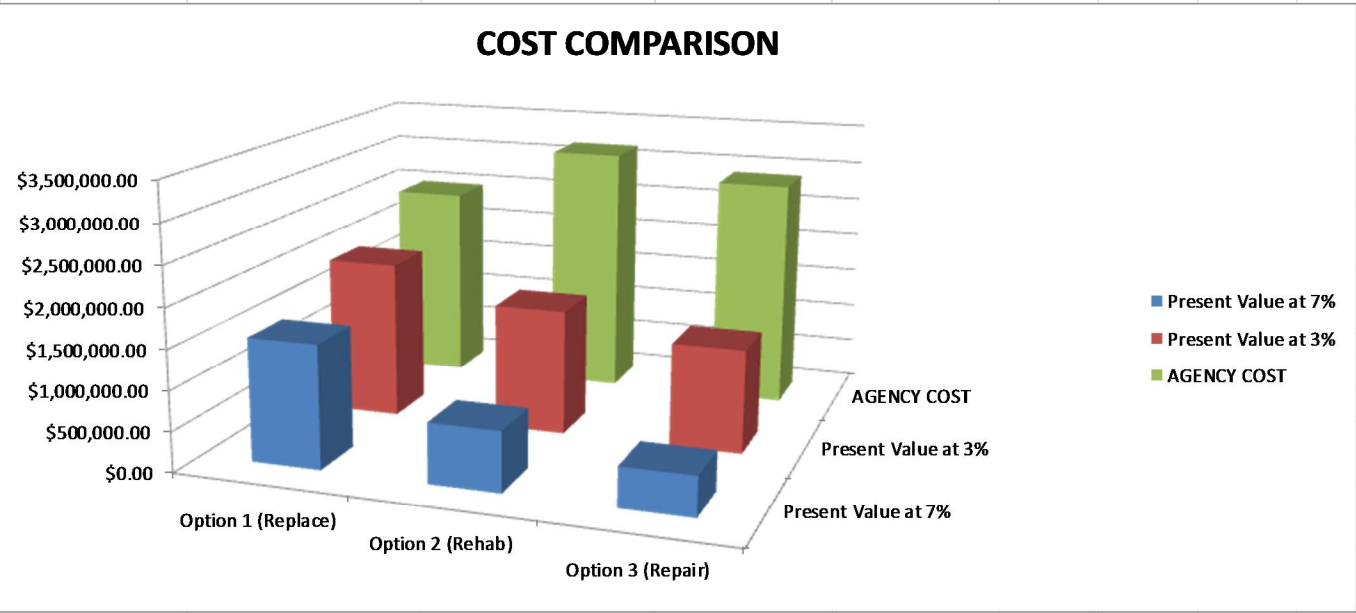
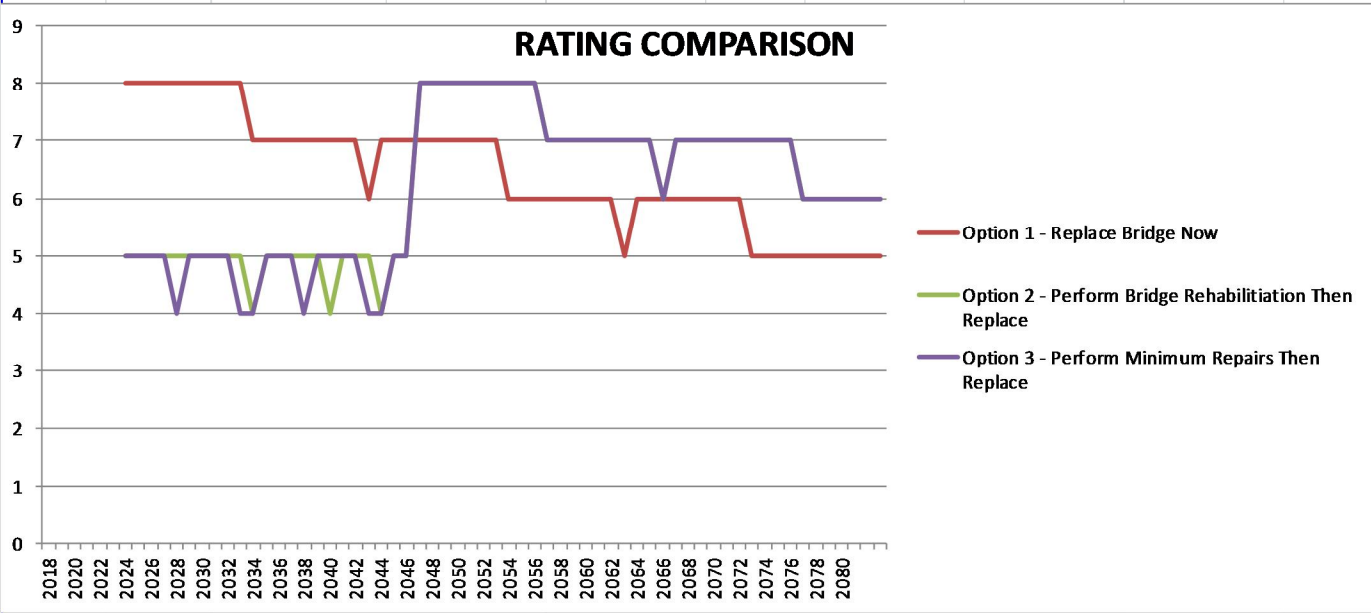
E HOLBROOK TI OP EB (#1369) / I-40 / MP 289.80

COST COMPARISON Present Value 2015 Dollars - Raw Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$ 2,485,962.36	\$1,978,812.77	\$1,535,914.46
Option 2 (Rehab)	\$ 3,168,053.87	\$1,573,400.15	\$741,725.93
Option 3 (Repair)	\$ 2,891,806.36	\$1,298,058.12	\$493,982.10

Comparison to Replacement			
Option	Agency Cost	3%	7%
2 (Rehab)	78.47%	125.77%	207.07%
3 (Repair)	85.97%	152.44%	310.93%

COST COMPARISON Present Value 2015 Dollars - Fully Loaded Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$5,469,117	\$4,353,388	\$3,379,012
Option 2 (Rehab)	\$6,969,719	\$3,461,480	\$1,631,797
Option 3 (Repair)	\$6,361,974	\$2,855,728	\$1,086,761

Bridge Ratings Per Option		
OPTION	AVG RATING	END RATING
Option 1 (Replace)	6.45	5
Option 2 (Rehab)	6.22	6
Option 3 (Repair)	6.17	6



Bridge History (Inspections/As-builts)											
Description							Category			Year	
Bridge originally built I-40-5(7)										1961	
New handrail details I-40-5(38)										1973	
BR-040-E(206)T:										2014	
1. Deck replacement							Replace (Deck)				
2. Superstructure replacement							Replace (Supr - Stl)				
Deck and superstructure are in very good condition since having been replaced in 2014. Therefore, a 20-year drop is assumed.											
Given the 2014 work, Option 2 has already taken place for superstructure/deck. Substructure evaluated only.											

Replace / Rehab / Repair Information				
BRIDGE DECK				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Deck)	Full Deck Replacement	\$85.94	25	Rating = 8
Rehab (Deck Concrete Overlay)	Overlay (Concrete)	\$10.00	15	+ 2
Rehab (Deck Epoxy Overlay)	Overlay (Epoxy)	\$5.00	10	+ 1
Repair (Deck)	Patch Spalls / Seal Cracks	\$3.00	See Deterioration Slope	+ 0
Replace (Bridge)	Full Bridge Replacement	\$171.88	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 0
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 0
SUPERSTRUCTURE - STEEL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Stl)	Full SuperStr Replacement	\$85.94	50	Rating = 8
Rehab (Supr - Stl)	Weld New Structural Components	\$42.97	15	+ 2
Repair (Supr - Stl)	Weld Repair / Crack Relief	\$5.00	See Deterioration Slope	+ 1
SUPERSTRUCTURE - CONCRETE				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Conc)	Full SuperStr Replacement	\$85.94	50	Rating = 8
Rehab (Supr - Conc)	Replace Structural Component	\$42.97	15	+ 2
Repair (Supr - Conc)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	\$171.88	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 1
SUBSTRUCTURE - STRUCTURAL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Substr)	Full SubStr Replacement	\$85.94	75	Rating = 8
Rehab (Substr)	Replace Structural Component	\$42.97	50	+ 2
Repair (Substr)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
SUBSTRUCTURE - SCOUR				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Rehab (Substr - Scour)	Add scour protection slabs	\$42.97	50	+ 2
Repair (Substr - Scour)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	\$171.88	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 1

September 2016 Appendix B - 54 I-40 East

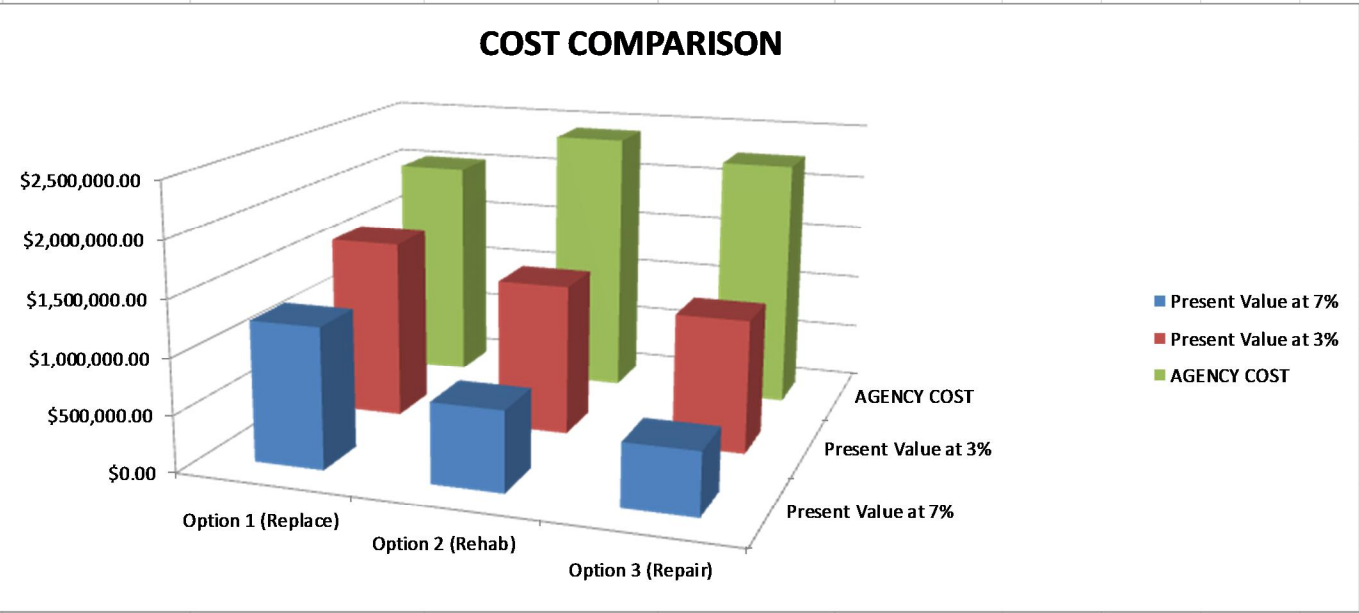
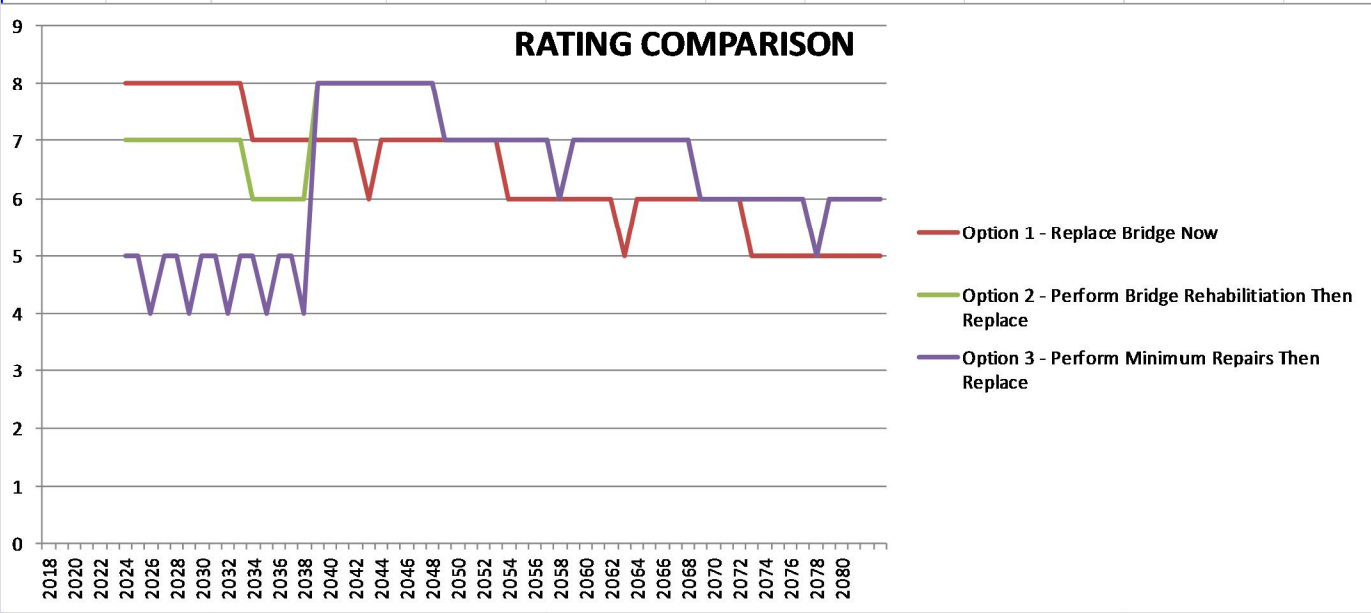
PAINTED DESERT TI UP (#590) / I-40 / MP 311.57

COST COMPARISON Present Value 2015 Dollars - Raw Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$ 2,033,140.10	\$1,610,736.46	\$1,247,221.89
Option 2 (Rehab)	\$ 2,409,127.60	\$1,348,754.05	\$702,586.96
Option 3 (Repair)	\$ 2,251,890.10	\$1,188,506.45	\$553,226.77

Comparison to Replacement			
Option	Agency Cost	3%	7%
2 (Rehab)	84.39%	119.42%	177.52%
3 (Repair)	90.29%	135.53%	225.44%

COST COMPARISON Present Value 2015 Dollars - Fully Loaded Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$4,472,908	\$3,543,620	\$2,743,888
Option 2 (Rehab)	\$5,300,081	\$2,967,259	\$1,545,691
Option 3 (Repair)	\$4,954,158	\$2,614,714	\$1,217,099

Bridge Ratings Per Option		
OPTION	AVG RATING	END RATING
Option 1 (Replace)	6.45	5
Option 2 (Rehab)	6.80	6
Option 3 (Repair)	6.30	6



Bridge History (Inspections/As-builts)											
Description							Category			Year	
Original I-40-5(29) construction - no additional work located for the bridge.										1964	
Latest inspection report shows medium longitudinal cracks in deck, with numerous hairline to narrow cracks on the soffit with exposed rebar											
and some minor spalling.											

Replace / Rehab / Repair Information				
BRIDGE DECK				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Deck)	Full Deck Replacement	\$97.66	25	Rating = 8
Rehab (Deck Concrete Overlay)	Overlay (Concrete)	\$10.00	15	+ 2
Rehab (Deck Epoxy Overlay)	Overlay (Epoxy)	\$5.00	10	+ 1
Repair (Deck)	Patch Spalls / Seal Cracks	\$3.00	See Deterioration Slope	+ 0
Replace (Bridge)	Full Bridge Replacement	\$195.31	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 0
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 0
SUPERSTRUCTURE - STEEL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Stl)	Full SuperStr Replacement	\$97.66	50	Rating = 8
Rehab (Supr - Stl)	Weld New Structural Components	\$48.83	15	+ 2
Repair (Supr - Stl)	Weld Repair / Crack Relief	\$5.00	See Deterioration Slope	+ 1
SUPERSTRUCTURE - CONCRETE				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Conc)	Full SuperStr Replacement	\$97.66	50	Rating = 8
Rehab (Supr - Conc)	Replace Structural Component	\$48.83	15	+ 2
Repair (Supr - Conc)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	\$195.31	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 1
SUBSTRUCTURE - STRUCTURAL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Substr)	Full SubStr Replacement	\$97.66	75	Rating = 8
Rehab (Substr)	Replace Structural Component	\$48.83	50	+ 2
Repair (Substr)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
SUBSTRUCTURE - SCOUR				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Rehab (Substr - Scour)	Add scour protection slabs	\$48.83	50	+ 2
Repair (Substr - Scour)	Patch Spalls / Seal Cracks	\$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	\$195.31	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	\$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	\$3.00	10	+ 1

WINDOW ROCK TI OP WB (#678) / I-40 / MP 357.53																					
Option 2 - Perform Bridge Rehabilitation Then Replace																					
Bridge Deck Area =		1394 SF										<div>Notes:</div> <div>1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.</div> <div>2. When superstructure replacement is selected, deck replacement should be selected as well.</div> <div>3. Deck Rehab does not account for any deck widening during replacement.</div> <div>4. Widened deck area applies to bridge replacement only.</div> <div>5. Repair deck (after bridge replace) should provide a deck deterioration of 1 point every 20 years. Repair (Deck) should maintain deck rating for life of repair, if the rating would otherwise drop a point (i.e., if the rating would drop from a "5" to a "4", Repair Deck would maintain a "5" at that year.)</div> <div>6. For other repair items, the "+" value rating should be applied to improve the bridge rating's value for that year.</div>									
Widen Deck Area =		1530 SF																			
Year Built =		1964																			
Exp Service Life =		75 YR																			

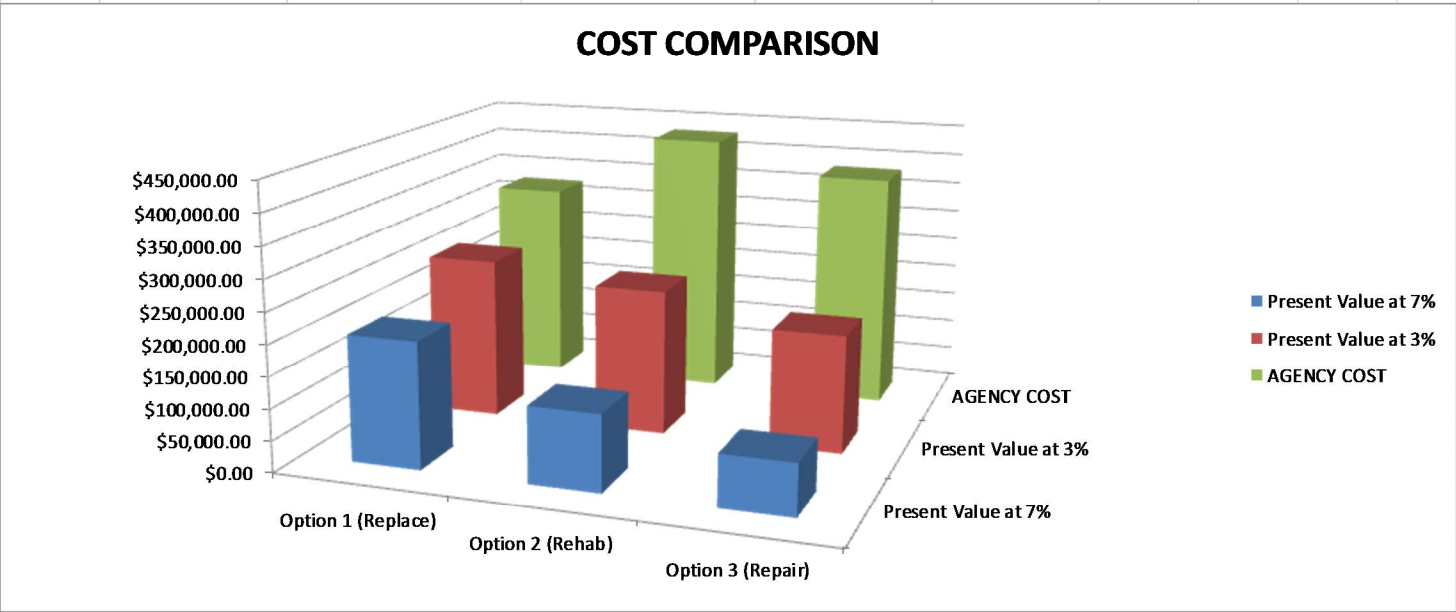
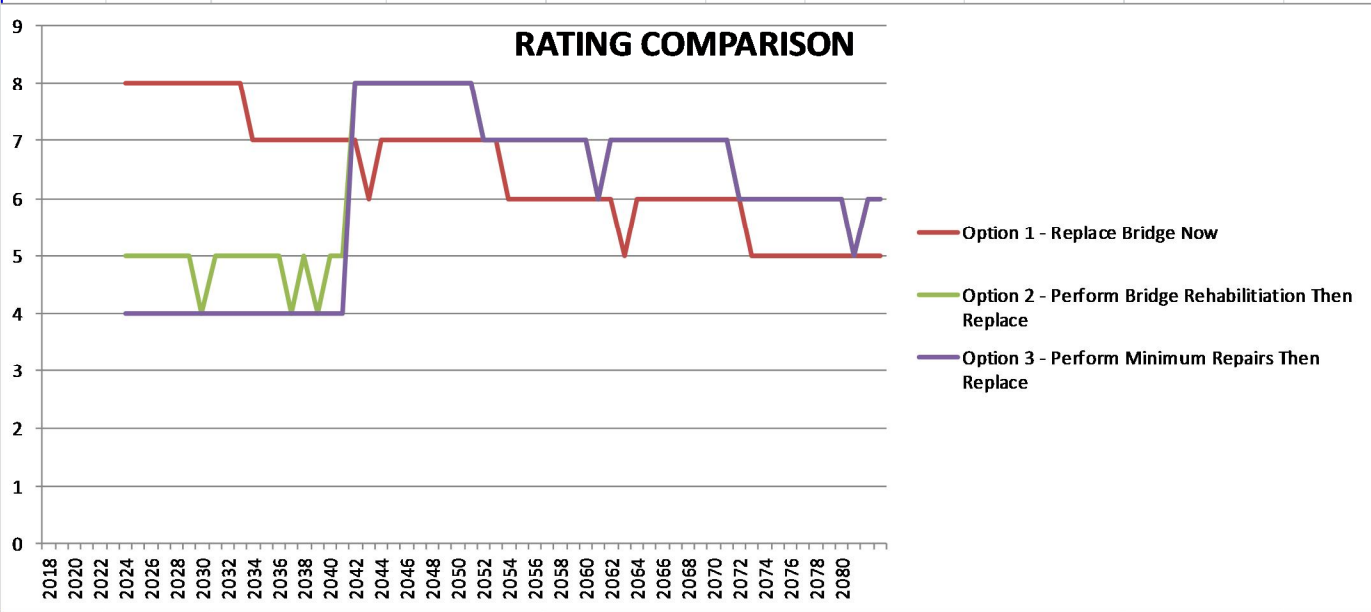
WINDOW ROCK TI OP WB (#678) / I-40 / MP 357.53

COST COMPARISON Present Value 2015 Dollars - Raw Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$ 326,364.30	\$260,180.99	\$202,103.13
Option 2 (Rehab)	\$ 430,673.84	\$234,477.71	\$121,020.12
Option 3 (Repair)	\$ 382,124.30	\$189,894.87	\$82,542.04

Comparison to Replacement			
Option	Agency Cost	3%	7%
2 (Rehab)	75.78%	110.96%	167.00%
3 (Repair)	85.41%	137.01%	244.85%

COST COMPARISON Present Value 2015 Dollars - Fully Loaded Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	\$718,001	\$572,398	\$444,627
Option 2 (Rehab)	\$947,482	\$515,851	\$266,244
Option 3 (Repair)	\$840,673	\$417,769	\$181,592

Bridge Ratings Per Option		
OPTION	AVG RATING	END RATING
Option 1 (Replace)	6.45	5
Option 2 (Rehab)	6.28	6
Option 3 (Repair)	6.03	6



Appendix C: Crash Modification Factors

SOLUTION	CONSTRUCTION COST	UNIT	FACTOR	TOTAL CONSTRUCTION COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
REHABILITATION							
Rehabilitate Pavement (AC)	\$276,500	Mile	2.20	\$610,000	Mill and replace 1"-3" AC pvmt; accounts for 38' width; for one direction of travel on two lane roadway; includes pavement, striping, delineators, RPMs, rumble strips	0.70	Combination of rehabilitate pavement (0.92), striping, delineators, RPMs (0.77 for combination), and rumble strips (0.89) = 0.70
Rehabilitate Bridge	\$65	SF	2.20	\$140	Based on deck area; bridge only - no other costs included	0.95	Assumed - should have a minor effect on crashes at the bridge
GEOMETRIC IMPROVEMENT							
Re-profile Roadway	\$974,500	Mile	2.20	\$2,140,000	Includes excavation of approximately 3", pavement replacement (AC), striping, delineators, RPMs, rumble strips, for one direction of travel of 2-lane roadway (38' width)	0.70	Assumed - this is similar to rehab pavement. This solution is intended to address vertical clearance at bridge, not profile issue.
Realign Roadway	\$2,960,000	Mile	2.20	\$6,510,000	All costs per direction except bridges; applicable to areas with small or moderate fills and cuts, minimal retaining walls	0.50	Based on CalTrans and NC DOT
Improve Skid Resistance	\$675,000	Mile	2.20	\$1,490,000	Average cost of pvmt replacement and variable depth paving to increase super-elevation; for one direction of travel on two lane roadway; includes pavement, striping, delineators, RPMs, rumble strips	0.66	Combination of avg of 5 values from clearinghouse (0.77) and calculated value from HSM (0.87) for skid resistance; striping, delineators, RPMs (0.77 for combination), and rumble strips (0.89) = 0.66
INFRASTRUCTURE IMPROVEMENT							
Reconstruct to Urban Section	\$1,000,000	Mile	2.20	\$2,200,000	Includes widening by 16' total (AC = 12'+2'+2') to provide median, curb & gutter along both side of roadway, single curb for median, striping (doesn't include widening for additional travel lane).	0.88	From HSM
Construct Auxiliary Lanes (AC)	\$914,000	Mile	2.20	\$2,011,000	For addition of aux lane (AC) in one direction of travel; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.78	Average of 4 values from clearinghouse
Construct Climbing Lane (High)	\$3,000,000	Mile	2.20	\$6,600,000	All costs except bridges; applicable to areas with large fills and cuts, retaining walls, rock blasting, steep slopes on both sides of road	0.75	From HSM

SOLUTION	CONSTRUCTION COST	UNIT	FACTOR	TOTAL CONSTRUCTION COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Construct Climbing Lane (Medium)	\$2,250,000	Mile	2.20	\$4,950,000	All costs except bridges; applicable to areas with medium or large fills and cuts, retaining walls, rock blasting, steep slopes on one side of road	0.75	From HSM
Construct Climbing Lane (Low)	\$1,500,000	Mile	2.20	\$3,300,000	All costs except bridges; applicable to areas with small or moderate fills and cuts, minimal retaining walls	0.75	From HSM
Construct Passing Lane	\$1,500,000	Mile	2.20	\$3,300,000	All costs except bridges; applicable to areas with small or moderate fills and cuts, minimal retaining walls	0.63	Average of 3 values from clearinghouse
Construct Reversible Lane (Low)	\$2,400,000	Lane-Mile	2.20	\$5,280,000	All costs except bridges; applicable to areas with small or moderate fills and cuts, minimal retaining walls	0.73 for uphill and 0.88 for downhill	Based on proposed conditions on I-17 with 2 reversible lanes and a conc barrier
Construct Reversible Lane (High)	\$4,800,000	Lane-Mile	2.20	\$10,560,000	All costs except bridges; applicable to areas with large fills and cuts, retaining walls, rock blasting, mountainous terrain	0.73 for uphill and 0.88 for downhill	Based on proposed conditions on I-17 with 2 reversible lanes and a conc barrier
Construct Entry/Exit Ramp	\$730,000	Each	2.20	\$1,610,000	Cost per ramp; includes pavement, striping, signing, RPMs, lighting, typical earthwork & drainage; does not include any major structures or improvements on crossroad	1.09	Average of 16 values on clearinghouse; for adding a ramp not reconstructing
Construct Turn Lanes	\$170,000	Each	2.20	\$374,000	Includes 14' roadway widening (AC) for one additional turn lane (250' long) on one leg of an intersection; includes AC pavement, curb & gutter, sidewalk, ramps, striping, and minor signal modifications	0.81	Average of 7 values from HSM
Modify Entry/Exit Ramp	\$445,000	Each	2.20	\$979,000	Cost per ramp; includes pavement, striping, signing, RPMs, lighting, minor earthwork, & drainage; For converting existing ramp to parallel-type configuration	0.21	Average of 4 values from clearinghouse (for exit ramps) and equation from HSM (for entrance ramp)
Widen & Modify Entry/Exit Ramp	\$619,000	Each	2.20	\$1,361,800	Cost per ramp; includes pavement, striping, signing, RPMs, lighting, minor earthwork, & drainage; For converting 1-lane ramp to 2-lane ramp and converting to parallel-type ramp	0.21	Will be same as "Modify Ramp"
Replace Pavement (AC)(with overexcavation)	\$1,446,500	Mile	2.20	\$3,180,000	Accounts for 38' width; for one direction of travel on two lane roadway; includes pavement, overexcavation, striping, delineators, RPMs, rumble strips	0.70	Same as rehab
Replace Pavement (PCCP)(with overexcavation)	\$1,736,500	Mile	2.20	\$3,820,000	Accounts for 38' width; for one direction of travel on two lane roadway; includes pavement, overexcavation, striping, delineators, RPMs, rumble strips	0.70	Same as rehab
Replace Bridge	\$125	SF	2.20	\$280	Based on deck area; bridge only - no other costs included	0.95	Assumed - should have a minor effect on crashes at the bridge

SOLUTION	CONSTRUCTION COST	UNIT	FACTOR	TOTAL CONSTRUCTION COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Widen Bridge	\$175	SF	2.20	\$390	Based on deck area; bridge only - no other costs included	0.90	Assumed - should have a minor effect on crashes at the bridge
Install Pedestrian Bridge	\$135	SF	2.20	\$300	Includes cost to construct bridge based on linear feet of the bridge. This costs includes and assumes ramps and sidewalks leading to the structure.	0.10 (ped only)	Assumed
Implement Automated Bridge De-icing	\$115	SF	2.20	\$250	Includes cost to replace bridge deck and install system	0.72 (snow/ice)	Average of 3 values on clearinghouse for snow/ice
Install Wildlife Crossing Under Roadway	\$650,000	Each	2.20	\$1,430,000	Includes cost of structure for wildlife crossing under roadway	0.25 (wildlife)	Assumed
Install Wildlife Crossing Over Roadway	\$1,140,000	Each	2.20	\$2,508,000	Includes cost of structure for wildlife crossing over roadway	0.25 (wildlife)	Assumed
Construct Drainage Structure - Minor	\$280,000	Each	2.20	\$616,000	Includes 3-36" pipes and roadway reconstruction (approx. 1,000 ft) to install pipes	0.70	Same as pavement rehab
Construct Drainage Structure - Intermediate	\$540,000	Each	2.20	\$1,188,000	Includes 5 barrel 8'x6' RCBC and roadway reconstruction (approx. 1,000 ft) to install RCBC	0.70	Same as pavement rehab
Construct Drainage Structure - Major	\$8,000	LF	2.20	\$17,600	Includes bridge that is 40' wide and reconstruction of approx. 500' on each approach	0.70	Same as pavement rehab
Install Center Turn Lane	\$450,000	Mile	2.20	\$990,000	Assumes widening (AC) of undivided facility to provide directional left-turn lane or two-way left-turn lane with associated transitions, signage and markings and standard shoulders; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.86	Average of 2 values from CMF Clearinghouse
OPERATIONAL IMPROVEMENT							
Implement Variable Speed Limits (Wireless, Overhead)	\$718,900	Mile	2.20	\$1,580,000	Includes 2 signs per mile (foundations and structures), wireless communication, detectors	0.92	From 1 value from clearinghouse
Implement Variable Speed Limits (Wireless, Ground-mount)	\$169,700	Mile	2.20	\$373,300	Includes 2 signs per mile (foundations and posts), wireless communication, detectors	0.92	From 1 value from clearinghouse
Implement Variable Speed Limits (Wireless, Solar, Overhead)	\$502,300	Mile	2.20	\$1,110,000	Includes 2 signs per mile (foundations and structures), wireless communication, detectors, solar power	0.92	From 1 value from clearinghouse
Implement Variable Speed Limits (Wireless, Solar, Ground-mount)	\$88,400	Mile	2.20	\$194,500	Includes 2 signs per mile (foundations and posts), wireless communication, detectors, solar power	0.92	From 1 value from clearinghouse
Implement Ramp Metering (Low)	\$25,000	Each	2.20	\$55,000	For each entry ramp location; urban area with existing ITS backbone infrastructure; includes signals, poles, timer, pull boxes, etc	0.64	From 1 value from clearinghouse

SOLUTION	CONSTRUCTION COST	UNIT	FACTOR	TOTAL CONSTRUCTION COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Implement Ramp Metering (High)	\$150,000	Mile	2.20	\$330,000	Area without existing ITS backbone infrastructure; in addition to ramp meters, also includes conduit, fiber optic lines, and power	0.64	From 1 value from clearinghouse
Implement Shoulder Running (ATM components only)	\$718,900	Mile	2.20	\$1,581,600	Includes overhead signs, wireless communication, etc, but does not include shoulder widening	0.78	Combination of adding climbing lane & reducing shldr when active, and increasing shldr when not active
Implement Shoulder Running (ATM and shoulder widening)	\$1,920,000	Mile	2.20	\$4,224,000	Includes overhead signs, communication backbone, etc, and shoulder widening with pavement striping, striping, etc to widen by 10'	0.78	Combination of adding climbing lane & reducing shldr when active, and increasing shldr when not active
Implement Shoulder Running (ATM and shoulder widening in mountainous terrain)	\$3,120,000	Mile	2.20	\$6,864,000	Includes overhead signs, communication backbone, etc, and shoulder widening in mountainous terrain with pavement striping, striping, etc to widen by 10'	0.78	Combination of adding climbing lane & reducing shldr when active, and increasing shldr when not active
Implement Signal Coordination	\$140,000	Mile	2.20	\$308,000	Includes conduit, conductors, and controllers for 4 intersections that span a total of approximately 2 miles.	0.90	Assumed
Implement Left-turn Phasing	\$7,500	Mile	2.20	\$16,500	Includes four new signal heads (two in each direction) and associated conductors for one intersection	0.88 (protected) 0.98 (perm/prot or prot/perm)	From HSM; CMF = 0.94 for each protected approach and 0.99 for each perm/prot or prot/perm approach. CMFs of different approaches should be multiplied together
ROADSIDE DESIGN							
Install Guardrail	\$130,000	Mile	2.20	\$286,000	One side of road	0.62 (ROR)	0.62 is avg of 2 values from clearinghouse
Install Cable Barrier	\$80,000	Mile	2.20	\$176,000		0.81	0.81 is average of 5 values from clearinghouse
Widen Shoulder (AC)	\$256,000	Mile	2.20	\$563,000	Assumes 10' of existing shoulder (combined left and right), includes widening shoulder by a total of 4'; new pavement for 4' width and mill and replace existing 10' width; includes pavement, minor earthwork, striping edge lines, RPMs, high-visibility delineators, and rumble strips	0.68 (1-4ft) 0.64 (4+ft)	0.86 is avg of 5 values from clearing house for widening shoulder 1-4'. 0.76 is calculated from HSM for widening shoulder >= 4'. Include striping, delineators, RPMs (0.77 combined CMF), and rumble strips (0.89). (Cost needs to be updated if dimension of existing and widened shoulder differ from Description.)
Rehabilitate Shoulder (AC)	\$113,000	Mile	2.20	\$249,000	One direction of travel (14' total shldr width-4' left and 10' right); includes paving (mill and replace), striping, high-visibility delineators, RPMs, and rumble strips for both shoulders	0.72	0.98 is average of 34 values on clearinghouse for shldr rehab/replace; include striping, delineators, RPMs (0.77 combined CMF), and rumble strips (0.89). (Cost needs to be updated if

SOLUTION	CONSTRUCTION COST	UNIT	FACTOR	TOTAL CONSTRUCTION COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
							dimension of existing shoulder differs from Description.)
Replace Shoulder (AC)	\$364,000	Mile	2.20	\$801,000	One direction of travel (14' total shldr width-4' left and 10' right); includes paving (full reconstruction), striping, high-visibility delineators, RPMs, and rumble strips for both shoulders	0.72	0.98 is average of 34 values on clearinghouse for shldr rehab/replace; include striping, delineators, RPMs (0.77 combined CMF), and rumble strips (0.89). (Cost needs to be updated if dimension of existing shoulder differs from Description.)
Install Rumble Strip	\$5,500	Mile	2.20	\$12,000	Both edges - one direction of travel; includes only rumble strip; no shoulder rehab or paving or striping	0.89	Average of 75 values on clearinghouse and consistent with HSM
Install Safety Edge	\$80,000	Mile	2.20	\$176,000		0.87	Average of 12 values on clearinghouse
Install Wildlife Fencing	\$340,000	Mile	2.20	\$748,000	Fencing only plus jump outs for 1 mile (both directions)	0.50 (wildlife)	Assumed
Remove Tree/Vegetation	\$200,000	Mile	2.20	\$440,000		0.62	CMF Clearinghouse for removal of fixed object
Install Centerline Rumble Strip	\$2,800	Mile	2.20	\$6,000	Includes rumble strip only; no pavement rehab or striping	0.85	From HSM
Install Access Barrier Fence	\$15	LF	2.20	\$33	8' fencing along one side of roadway	0.10 (ped only)	Assumed
Install Rock-Fall Mitigation – Wire Mesh	\$1,320,000	Mile	2.20	\$2,904,000	Includes wire mesh and rock stabilization (one direction only)	0.75 (debris)	Assumed
Install Rock-Fall Mitigation – Containment Fence & Barrier	\$2,112,000	Mile	2.20	\$4,646,000	Includes containment fencing, concrete barrier, and rock stabilization (one direction only)	0.75 (debris)	Assumed
Install Raised Concrete Barrier in Median	\$650,000	Mile	2.20	\$1,430,000	Includes concrete barrier with associated striping and reflective markings; excludes lighting in barrier (one direction)	0.90 (Cross-median and head on crashes eliminated completely)	All cross median and head-on fatal or incapacitating injury crashes are eliminated completely; all remaining crashes have 0.90 applied
INTERSECTION IMPROVEMENT							
Construct Traffic Signal	\$150,000	Each	2.20	\$330,000	4-legged intersection; includes poles, foundations, conduit, controller, heads, luminaires, mast arms, etc.	0.95	From HSM
Improve Signal Visibility	\$35,000	Each	2.20	\$77,000	4-legged intersection; signal head size upgrade, installation of new back-plates, and installation of additional signal heads on new poles.	0.85	Average of 7 values on clearinghouse

SOLUTION	CONSTRUCTION COST	UNIT	FACTOR	TOTAL CONSTRUCTION COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Install Raised Median	\$360,000	Mile	2.20	\$792,000	Includes removal of 14' wide pavement and construction of curb & gutter; does not include cost to widen roadway to accommodate the median; if the roadway needs to be widened, include cost from New General Purpose Lane	0.83	Average from HSM
Install Transverse Rumble Strip	\$3,000	Each	2.20	\$7,000	Includes pedestrian markings and rumble strips only across a 30' wide travel-way; no pavement rehab or other striping	0.95	Average of 17 values on clearinghouse
Construct Single-Lane Roundabout	\$1,500,000	Each	2.20	\$3,300,000	Removal of signal at 4-legged intersection; realignment of each leg for approx. 800 feet including paving, curbs, sidewalk, striping, lighting, signing	0.22	From HSM
Construct Double-Lane Roundabout	\$1,800,000	Each	2.20	\$3,960,000	Removal of signal at 4-legged intersection; realignment of each leg for approx. 800 feet including paving, curbs, sidewalk, striping, lighting, signing	0.40	From HSM
ROADWAY DELINEATION							
Install High-Visibility Edge Line Striping	\$10,800	Mile	2.20	\$23,800	2 edge lines and lane line - one direction of travel	0.77	Avg of 3 values from clearinghouse. Assumes package of striping, delineators, and RPMs (if implemented separately, CMF will be higher)
Install High-Visibility Delineators	\$6,500	Mile	2.20	\$14,300	Both edges - one direction of travel		Avg of 3 values from clearinghouse. Assumes package of striping, delineators, and RPMs (if implemented separately, CMF will be higher)
Install Raised Pavement Markers	\$2,000	Mile	2.20	\$4,400	Both edges - one direction of travel		Avg of 3 values from clearinghouse. Assumes package of striping, delineators, and RPMs (if implemented separately, CMF will be higher)
Install In-Lane Route Markings	\$6,000	Each	2.20	\$13,200	Installation of a series of three in-lane route markings in one lane	0.95	Assumed
IMPROVED VISIBILITY							
Cut Side Slopes	\$80	Lin Ft	2.20	\$200	For small grading to correct sight distance issues; not major grading	0.85	Intent of this solution is to improve sight distance. Most CMF's are associated with vehicles traveling on slope. Recommended CMF is based on FDOT and NCDOT but is more conservative.
Install Lighting (connect to existing power)	\$270,000	Mile	2.20	\$594,000	One side of road only; offset lighting, not high-mast; does not include power supply; includes poles, luminaire, pull boxes, conduit, conductor	0.75 (night)	Average of 3 values on clearinghouse & consistent with HSM

SOLUTION	CONSTRUCTION COST	UNIT	FACTOR	TOTAL CONSTRUCTION COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Install Lighting (solar powered LED)	\$10,000	Pole	2.20	\$22,000	Offset lighting, not high-mast; solar power LED; includes poles, luminaire, solar panel	0.75 (night)	Average of 3 values on clearinghouse & consistent with HSM
DRIVER INFORMATION/WARNING							
Install Dynamic Message Sign (DMS)	\$250,000	Each	2.20	\$550,000	Includes sign, overhead structure, and foundations; wireless communication; does not include power supply	1.00	Not expected to reduce crashes
Install Dynamic Weather Warning Beacons	\$40,000	Each	2.20	\$88,000	Assumes solar operation and wireless communication or connection to existing power and communication; ground mounted; includes posts, foundations, solar panel, and dynamic sign	0.65 (weather related)	Avg of 3 values from HSM for dynamic/changeable warning signs
Install Speed Feedback Signs	\$25,000	Each	2.20	\$55,000	Assumes solar operation and no communication; ground mounted; includes regulatory sign, posts, foundations, solar panel, and dynamic sign	0.54	From HSM
Install Chevrons	\$18,400	Mile	2.20	\$40,500	On one side of road - includes signs, posts, and foundations	0.79	Average of 11 values on clearinghouse
Install Warning Signs	\$2,500	Each	2.20	\$5,500	Includes 2 signs, posts, and foundations	0.83	Average of 4 clearinghouse values
Install Wildlife Warning System	\$162,000	Each	2.20	\$356,400	Includes wildlife detection system, flashing warning signs (assumes solar power), advance signing, CCTV (solar and wireless), and fencing for approximately 2 miles in each direction	0.50 (wildlife)	Assumed
Install Warning Sign with Beacons	\$15,000	Each	2.20	\$33,000	In both directions; includes warning sign, post, and foundation, and flashing beacons (assumes solar power) at one location	0.75	FHWA Desktop Reference for Installing Flashing Beacons as Advance Warning = 0.75
Install Larger Stop Sign with Beacons	\$10,000	Each	2.20	\$22,000	In one direction; includes large stop sign, post, and foundation, and flashing beacons (assumes solar power) at one location	0.85/0.81	Use 0.85 for adding beacons to an existing sign; 0.81 for installing a larger sign with flashing beacons
DATA COLLECTION							
Install Roadside Weather Information System (RWIS)	\$60,000	Each	2.20	\$132,000	Assumes wireless communication and solar power, or connection to existing power and communications	1.00	Not expected to reduce crashes
Install Closed Circuit Television (CCTV) Camera	\$25,000	Each	2.20	\$55,000	Assumes connection to existing ITS backbone or wireless communication; does not include fiber-optic backbone infrastructure; includes pole, camera, etc	1.00	Not expected to reduce crashes
Install Vehicle Detection Stations	\$15,000	Each	2.20	\$33,000	Assumes wireless communication and solar power, or connection to existing power and communications	1.00	Not expected to reduce crashes
Install Flood Sensors (Activation)	\$15,000	Each	2.20	\$33,000	Sensors with activation cabinet to alert through texting (agency)	1.00	Not expected to reduce crashes

SOLUTION	CONSTRUCTION COST	UNIT	FACTOR	TOTAL CONSTRUCTION COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Install Flood Sensors (Gates)	\$100,000	Each	2.20	\$220,000	Sensors with activation cabinet to alert through texting (agency) and beacons (public) plus gates	1.00	Not expected to reduce crashes
WIDEN CORRIDOR							
Construct New General Purpose Lane (PCCP)	\$1,740,000	Mile	2.20	\$3,830,000	For addition of 1 GP lane (PCCP) in one direction; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.90	North Carolina DOT uses 0.90 and Florida DOT uses 0.87
Construct New General Purpose Lane (AC)	\$1,200,000	Mile	2.20	\$2,640,000	For addition of 1 GP lane (AC) in one direction; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.90	North Carolina DOT uses 0.90 and Florida DOT uses 0.88
Convert a 2-lane undivided highway to a 5-lane highway	\$1,576,000	Mile	2.20	\$3,467,200	For expanding a 2-lane undivided highway to a 5-lane highway (4 through lanes with TWLTL), includes standard shoulder widths but no curb, gutter, or sidewalks	0.70	Assumed to be slightly lower than converting from a 4-lane to a 5-lane highway
Convert a 4-lane undivided highway to a 5-lane highway	\$1,053,000	Mile	2.20	\$2,316,600	For expanding a 4-lane undivided highway to a 5-lane highway (4 through lanes with TWLTL), includes standard shoulder widths but no curb, gutter, or sidewalk	0.75	From FHWA Desktop Reference for CRFs, CMF Clearinghouse, and SR 87 CPS comparison
Construct 4-lane Divided Highway (Using Existing 2-lane Road for one direction)	\$3,000,000	Mile	2.20	\$6,600,000	In both directions; one direction uses existing 2-lane road; other direction assumes addition of 2 new lanes (AC) with standard shoulders; includes all costs except bridges	0.67	Assumed
Construct 4-lane Divided Highway (No Use of Existing Roads)	\$6,000,000	Mile	2.20	\$13,200,000	In both directions; assumes addition of 2 new lanes (AC) with standard shoulders in each direction; includes all costs except bridges	0.67	Assumed
Construct Bridge over At-Grade Railroad Crossing	\$10,000,000	Each	2.20	\$22,000,000	Assumes bridge width of 4 lanes (AC) with standard shoulders; includes abutments and bridge approaches; assumes vertical clearance of 23'4" + 6'8" superstructure	0.72 (All train-related crashes eliminated)	Removes all train-related crashes at at-grade crossing; all other crashes CMF = 0.72
Construct Underpass at At-Grade Railroad Crossing	\$15,000,000	Each	2.20	\$33,000,000	Assumes underpass width of 4 lanes (AC) with standard shoulders; includes railroad bridge with abutments and underpass approaches; assumes vertical clearance of 16'6" + 6'6" superstructure	0.72 (All train-related crashes eliminated)	Removes all train-related crashes at at-grade crossing; all other crashes CMF = 0.72
Construct High-Occupancy Vehicle (HOV) Lane	\$900,000	Mile	2.20	\$1,980,000	For addition of 1 HOV lane (AC) in one direction with associated signage and markings; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.95	Similar to general purpose lane
ALTERNATE ROUTE							

SOLUTION	CONSTRUCTION COST	UNIT	FACTOR	TOTAL CONSTRUCTION COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Construct Frontage Roads	\$2,400,000	Mile	2.20	\$5,280,000	For 2-lane AC frontage road; includes all costs except bridges; for generally at-grade facility with minimal walls	0.90	Assumed - similar to new general purpose lane
Construct 2-lane Undivided Highway	\$3,000,000	Mile	2.20	\$6,600,000	In both directions; assumes addition of 2 new lanes (AC) with standard shoulders in each direction; includes all costs except bridges	0.90	Assuming new alignment for a bypass

Appendix D: Performance Area Risk Factors

Pavement Performance Area

- Mainline Daily Traffic Volume
- Mainline Daily Truck Volume
- Elevation
- Interrupted Flow

Elevation

Variance above 4000' divided by 1000; (Elev-4000)/1000

Score	Condition
0	< 4000'
0-5	4000'- 9000'
5	> 9000'

Mainline Daily Traffic Volume

Exponential equation; score = 5-(5*e^(ADT*-0.000039))

Score	Condition
0	< 6,000
0-5	6,000 – 160,000
5	>160,000

Mainline Daily Truck Volume

Exponential equation; score = 5-(5*e^(ADT*-0.00025))

Score	Condition
0	<900
0-5	900-25,000
5	>25,000

Interrupted Flow

Score	Condition
0	Not interrupted flow
5	Interrupted Flow

Bridge Performance Area

- Mainline Daily Traffic Volume
- Detour Length
- Elevation
- Scour Critical Rating
- Carries Mainline Traffic
- Vertical Clearance

Mainline Daily Traffic Volume

Exponential equation; score = 5-(5*e^(ADT*-0.000039))

Score	Condition
0	<6,0000
0-5	6,000-160,000
5	>160,000

Elevation

Variance above 4000' divided by 1000; (Elev-4000)/1000

Score	Condition
0	< 4000'
0-5	4000'- 9000'
5	> 9000'

Carries Mainline

Score	Condition
0	Does not carry mainline traffic
5	Carries mainline traffic

Detour Scale

Divides detour length by 10 and multiplies by 2.5

Score	Condition
0	0 miles
0-5	0-20 miles
5	> 20 miles

Scour

Variance below 8

Score	Condition
0	Rating > 8
0-5	Rating 8 - 3
5	Rating < 3

Vertical Clearance

Variance below 16' x 2.5; (16 –Clearance) x 2.5

Score	Condition
0	>16'
0-5	16'-14'
5	<14'

Mobility Performance Area

- Mainline VMT
- Detour Length
- Buffer Index (PTI-TTI)
- Shoulder width

Mainline VMT

Exponential equation; score = $5-(5 \cdot e^{(ADT \cdot -0.0000139)})$

Score	Condition
0	<16,000
0-5	16,000-400,000
5	>400,000

Buffer Index

Buffer Index x 10

Score	Condition
0	Buffer Index = 0.00
0-5	Buffer Index 0.00-0.50
5	Buffer Index > 0.50

Detour Length

Score	Condition
0	Detour < 10 miles
5	Detour > 10 miles

Shoulder Width

Variance below 10', if only 1 lane in each direction

Score	Condition
0	10' or above or >1 lane in each direction
0-5	10'-5' and 1 lane in each direction
5	5' or less and 1 lane in each direction

Safety Performance Area

- Mainline Daily Traffic Volume
- Vertical Grade
- Shoulder width (Right)
- Elevation
- Interrupted Flow

Mainline Daily Traffic Volume

Exponential equation; score = $5-(5 \cdot e^{(ADT \cdot -0.000039)})$

Score	Condition
0	<6,000
0-5	6,000-160,000
5	>160,000

Interrupted Flow

Score	Condition
0	Not interrupted flow
5	Interrupted Flow

Elevation

Variance above 4000' divided by 1000; (Elev-4000)/1000

Score	Condition
0	< 4000'
0-5	4000'- 9000'
5	> 9000'

Shoulder (Right side)

Variance below 10'

Score	Condition
0	10' or above
0-5	10' - 5'
5	5' or less

Grade

Variance above 3% x 1.5

Score	Condition
0	< 3%
0-5	3% - 6.33%
5	>6.33%

Freight Performance Area

- Mainline Daily Truck Volume
- Detour Length
- Truck Buffer Index (TPTI-TTTI)
- Shoulder width

Mainline Daily Truck Volume

Exponential equation; score = $5-(5 \cdot e^{(ADT \cdot -0.00025)})$

Score	Condition
0	<900
0-5	900-25,000
5	>25,000

Detour Length

Score	Condition
0	Detour < 10 miles
5	Detour > 10 miles

Truck Buffer Index

Truck Buffer Index x 10

Score	Condition
0	Buffer Index = 0.00
0-5	Buffer Index 0.00-0.50
5	Buffer Index > 0.50

Shoulder Width

Variance below 10', if only 1 lane in each direction

Score	Condition
0	10' or above or >1 lane in each direction
0-5	10'-5' and 1 lane in each direction
5	5' or less and 1 lane in each direction

Performance Area Risk Factors

Solution Number	Mainline Traffic Vol (vpd) (2-way)	Solution Length (miles)	Bridge Detour Length (miles) (N19)	Elevation (ft)	Scour Critical Rating (0-9)	Carries Mainline Traffic (Y/N)	Bridge Vert. Clear (ft)	Mainline Truck Vol (vpd) (2-way)	Detour Length > 10 miles (Y/N)	Truck Buffer Index	Non-Truck Buffer Index	Grade (%)	Interrupted Flow (Y/N)	Outside/ Right Shoulder Width (ft)	1-lane each direction
3	39,682	4		6,950				8,980	n	0.14	0.17	3.0	n	10	n
4	39,682	6		6,950				8,980	n	0.14	0.17	3	n	10	n
5	39,682	2		6,950				8,980	n	0.14	0.17	3	n	10	n
6	39,682	1		6,850				8,980	n	0.14	0.17	2.3	n	10	n
7A	39,682	2		6,820				8,980	n	0.14	0.17	2	n	10	n
7B	19,062	5		6,790				6,336	y	0.10	0.31	3.6	n	10	n
8	19,062	2		6,670				6,336	y	0.10	0.31	3.6	n	10	n
9	19,062	5		6,500				6,336	y	0.10	0.31	2.9	n	10	n
10	19,062	4		6,790				6,336	y	0.10	0.31	3.6	n	10	n
11	19,062	3		6,790				6,336	y	0.10	0.31	3	n	10	n
12	16,150	2		5,980				5,446	y	0.09	0.26	2.1	n	10	n
13	16,150	9		5,860				5,446	y	0.09	0.26	2.4	n	10	n
14	16,150	1		5,870				5,446	y	0.09	0.26	2.1	n	10	n
15	16,150	1		5,520				5,446	y	0.09	0.26	2.4	n	10	n
17	16,110	8		4,980				6,196	Y	0.08	0.2	1.3	N	10	N
24	16,008	6		6,080				6,325	N	0.12	0.3	4.1	N	10	N
25	16,008	9		6,190				6,325	n	0.12	0.3	2.9	N	10	N
26	16,008	3		6,190				6,325	N	0.12	0.3	4.1	N	10	N

Solution Number	Bridge	Pavement	Mobility	Safety	Freight	Risk Score (0 to 10)				
						Bridge	Pavement	Mobility	Safety	Freight
3			y	y	y	0.00	0.00	3.07	2.75	2.94
4			y	y	y	0.00	0.00	3.26	2.75	2.94
5			y	y	y	0.00	0.00	2.52	2.75	2.94
6			y	y	y	0.00	0.00	1.91	2.71	2.94
7A			y	y	y	0.00	0.00	2.52	2.70	2.94
7B			y	y	y	0.00	0.00	5.88	2.52	4.99
8			y	y	y	0.00	0.00	5.08	2.47	4.99
9			y	y	y	0.00	0.00	5.88	2.04	4.99
10			y	y	y	0.00	0.00	5.68	2.52	4.99
11		y	y	y	y	0.00	6.25	5.42	2.16	4.99
12			y	y	y	0.00	0.00	4.70	1.72	4.81
13			y	y	y	0.00	0.00	5.97	1.67	4.81
14			y	y	y	0.00	0.00	4.30	1.68	4.81
15			y	y	y	0.00	0.00	4.30	1.54	4.81
17			y	y	Y	0.00	0.00	5.58	1.32	4.87
24			y	y	Y	0.00	0.00	3.34	2.41	2.59
25			y	y	y	0.00	0.00	3.66	1.80	2.59
26			y	y	Y	0.00	0.00	2.72	2.46	2.59

Appendix E: Performance Effectiveness Scores

I-40 East Candidate Solution Need Benefit Scoring

LEGEND:

- user entered value

- calculated value for reference only

- calculated value for entry/use in other spreadsheet

- for input into Performance Effectiveness Score spreadsheet

- assumed values (do not modify)

Solution #	40.3	40.4	40.5	40.6	40.7-A	40.7-B	40.08	40.9	40.10	40.11	40.12	40.13	40.14	40.15
Description	Flagstaff Area Safety Improvements	Lighting Improvements	Ped Improvements	Butler TI	East Flagstaff Safety Improvements	East Flagstaff Safety Improvements	TI Lighting	Winona Safety	Country Club & Walnut Canyon	Pavement	Canyon Diablo West Curves	Canyon Diablo Middle	Twin Arrows TI	Canyon Diablo East Curves
Project Beg MP	196	196	198	198.5	200	202	204.5	207	201.5	202	218	220	219.5	229
Project End MP	200	202	200	199.5	202	207	207.5	212	205.5	205	220	229	220.5	230
Project Length (miles)	4	6	2	1	2	5	3	5	4	3	2	9	1	1
Segment Beg MP	196	196	196	196	196	202	202	202	202	202	212	212	212	212
Segment End MP	202	202	202	202	202	212	212	212	212	212	234	234	234	234
Segment Length (miles)	6	6	6	6	6	10	10	10	10	10	22	22	22	22
Segment #	1	1	1	1	1	2	2	2	2	2	3	3	3	3
Current # of Lanes (both directions)	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Project Type (one-way or two-way)	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	one-way	two-way	two-way	two-way	two-way
Additional Lanes (one-way)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pro-Rated # of Lanes	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00

		Notes and Directions	Description														
SAFETY	DIRECTIONAL SAFETY	Input current value from performance system (direction 1)	Orig Segment Directional Safety Index (direction 1)	1.558	1.558	1.558	1.558	1.558	2.408	2.408	2.408	2.408	2.408	1.460	1.460	1.460	1.460
		Input current value from performance system (direction 1)	Orig Segment Directional Fatal Crashes (direction 1)	3	3	3	3	3	4	4	4	4	4	5	5	5	5
		Input current value from performance system (direction 1)	Orig Segment Directional Incap Crashes (direction 1)	4	4	4	4	4	5	5	5	5	5	4	4	4	4
		Input current value from performance system (direction 1)	Original Fatal Crashes in project limits (direction 1)	1	2	1	1	2	1	1	3	1	0	2	1	1	0
		Input current value from performance system (direction 1)	Original Incap Crashes in project limits (direction 1)	2	3	0	0	2	2	0	3	2	2	0	3	0	1
		Input CMF value (direction 1) - If no CMF enter 1.0	CMF 1 (direction 1)	0.77	0.75	0.1	0.21	0.67	0.77	0.75		0.21	0.71	0.67	0.77	0.21	0.67
		Input CMF value (direction 1) - If no CMF enter 1.0	CMF 2 (direction 1)	0.87	1	1	1	0.79	0.87	1		1	1	0.79	0.87	1	0.79
				0.86	1	1	1	0.87	0.86	1		1	1	0.87	0.86	1	0.87
		Input CMF value (direction 1) - If no CMF enter 1.0	CMF 3 (direction 1)	0.92	1	1	1	0.77	0.92	1		1	1	0.77	1	1	0.77
		Calculated Value (direction 1)	Total CMF (direction 1)	0.643	0.750	0.100	0.210	0.500	0.643	0.750	0.500	0.210	0.710	0.500	0.670	0.210	0.500
		Calculated Value (direction 1)	Fatal Crash reduction (direction 1)	0.357	0.500	0.900	0.790	1.000	0.357	0.250	1.500	0.790	0.000	1.000	0.330	0.790	0.000
		Calculated Value (direction 1)	Incap Crash reduction (direction 1)	0.714	0.750	0.000	0.000	1.000	0.714	0.000	1.500	1.580	0.580	0.000	0.991	0.000	0.500
		Enter in Safety Index spreadsheet to calculate new Safety Index (direction 1)	Post-Project Segment Directional Fatal Crashes (direction 1)	2.643	2.500	2.100	2.210	2.000	3.643	3.750	2.643	3.210	4.000	4.000	4.670	4.210	5.000
		Enter in Safety Index spreadsheet to calculate new Safety Index (direction 1)	Post-Project Segment Directional Incap Crashes (direction 1)	3.286	3.250	4.000	4.000	3.000	4.286	5.000	3.500	3.420	4.420	4.000	3.009	4.000	3.500
		Input value from updated Safety Index spreadsheet (direction 1)	Post-Project Segment Directional Safety Index (direction 1)	1.360	1.300	1.130	1.180	1.050	2.180	2.270	1.600	1.910	2.390	1.180	1.350	1.240	1.450
		Enter in Safety Needs spreadsheet to calculate new segment level Safety Need (direction 1)	Post-Project Segment Directional Safety Index (direction 1)	1.360	1.300	1.130	1.180	1.050	2.180	2.270	1.600	1.910	2.390	1.180	1.350	1.240	1.450
		Input current value from performance system (direction 2)	Orig Segment Directional Safety Index (direction 2)	1.973	1.973	1.973	1.973	1.973	1.364	1.364	1.364	1.364	1.364	1.230	1.230	1.230	1.230
		Input current value from performance system	Orig Segment Directional Fatal Crashes (direction	4	4	4	4	4	2	2	2	2	2	4	4	4	4

		Solution #		40.3	40.4	40.5	40.6	40.7-A	40.7-B	40.08	40.9	40.10	40.11	40.12	40.13	40.14	40.15
MOBILITY		(direction 2)	2)														
		Input current value from performance system (direction 2)	Orig Segment Directional Incap Crashes (direction 2)	2	2	2	2	2	6	6	6	6	6	6	6	6	6
		Input current value from performance system (direction 2)	Original Fatal Crashes in project limits (direction 2)	4	3	3	1	0	1	2	1	0		1	2	1	1
		Input current value from performance system (direction 2)	Original Incap Crashes in project limits (direction 2)	2	1	0	1	0	4	1	2	0		1	3	1	0
		Input CMF value (direction 2) - If no CMF enter 1.0	CMF 1 (direction 2)	0.77	0.75	0.1	0.21	0.67	0.77	0.75		0.21	0.71	0.67	0.77	0.21	0.67
		Input CMF value (direction 2) - If no CMF enter 1.0	CMF 1 (direction 2)	0.87	1	1	1	0.79	0.87	1		1	1	0.79	0.87	1	0.79
				0.86	1	1	1	0.87	0.86	1		1	1	0.87	0.86	1	0.87
		Input CMF value (direction 2) - If no CMF enter 1.0	CMF 1 (direction 2)	0.92	1	1	1	0.77	0.92	1		1	1	0.77	1	1	0.77
		Calculated Value (direction 2)	Total CMF (direction 2)	0.643	0.750	0.100	0.210	0.500	0.643	0.750	0.500	0.210	0.710	0.500	0.670	0.210	0.500
		Calculated Value (direction 2)	Fatal Crash reduction (direction 2)	1.429	0.750	2.700	0.790	0.000	0.357	0.500	0.500	0.000	0.000	0.500	0.661	0.790	0.500
		Calculated Value (direction 2)	Incap Crash reduction (direction 2)	0.714	0.250	0.000	0.790	0.000	1.429	0.250	1.000	0.000	0.000	0.500	0.991	0.790	0.000
		Enter in Safety Index spreadsheet to calculate new Safety Index (direction 2)	Post-Project Segment Directional Fatal Crashes (direction 2)	2.571	3.250	1.300	3.210	4.000	1.643	1.500	1.500	2.000	2.000	3.500	3.339	3.210	3.500
		Enter in Safety Index spreadsheet to calculate new Safety Index (direction 2)	Post-Project Segment Directional Incap Crashes (direction 2)	1.286	1.750	2.000	1.210	2.000	4.571	5.750	5.143	6.000	6.000	5.500	5.009	5.210	6.000
		Input value from updated Safety Index spreadsheet (direction 2)	Post-Project Segment Directional Safety Index (direction 2)	1.270	1.610	0.690	1.570	1.970	1.110	1.070	1.050	1.360	1.360	1.080	1.030	1.000	1.090
		Enter in Safety Needs spreadsheet to calculate new segment level Safety Need (direction 2)	Post-Project Segment Directional Safety Index (direction 2)	1.270	1.610	0.690	1.570	1.970	1.110	1.070	1.050	1.360	1.360	1.080	1.030	1.000	1.090
	SAFETY INDEX	Calculated Value - verify that it matches current performance system	Current Safety Index	1.766	1.766	1.766	1.766	1.766	1.886	1.886	1.886	1.886	1.886	1.345	1.345	1.345	1.345
		Enter in Safety Needs spreadsheet to calculate new segment level Safety Need	Post-Project Safety Index	1.315	1.455	0.910	1.375	1.510	1.645	1.670	1.325	1.635	1.875	1.130	1.190	1.120	1.270
	Needs	User entered value from Safety Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Safety Need	5.296	5.296	5.296	5.296	5.296	4.964	4.964	4.964	4.964	4.964	3.164	3.164	3.164	3.164
		User entered value from Safety Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Safety Need	3.35	3.932	1.198	3.607	4.179	4.150	4.228	3.072	4.117	4.917	2.431	2.617	2.375	2.9
	MOBILITY INDEX	Input current value from performance system	Original Segment Mobility Index	0.710	0.710	0.710	0.710	0.710	0.420	0.420	0.420	0.420	0.420	0.490	0.490	0.490	0.490
		Enter in Mobility Index Spreadsheet to determine new segment level Mobility Index	Post-Project # of Lanes (both directions)	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Mobility Index	0.69	0.71	0.71	0.71	0.71	0.42	0.42	0.40	0.42	0.42	0.49	0.49	0.49	0.49
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Mobility Index	0.687	0.710	0.710	0.710	0.710	0.420	0.420	0.400	0.420	0.420	0.490	0.490	0.490	0.490
	FUT V/C	Input current value from performance system	Original Segment Future V/C	0.900	0.900			0.900	0.580		0.580						
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Future V/C	0.876	0.900			0.900	0.580		0.553						
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Future V/C	0.876	0.900	0.000	0.000	0.900	0.580	0.000	0.553	0.000		0.000	0.000	0.000	0.000
	PEAK HOUR V/C	Input current value from performance system (direction 1)	Original Segment Peak Hour V/C (direction 1)	0.400	0.400			0.400	0.200		0.200						
		Input current value from performance system	Original Segment Peak Hour V/C (direction 2)	0.390	0.390			0.390	0.160		0.160						

			Solution #	40.3	40.4	40.5	40.6	40.7-A	40.7-B	40.08	40.9	40.10	40.11	40.12	40.13	40.14	40.15
		(direction 2)															
		*If One-Way project, enter in Mobility Index Spreadsheet to determine new segment level Peak Hour V/C. If Two-Way project, disregard	Adjusted total # of Lanes for use in directional peak hr	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
		Input value from updated Mobility Index spreadsheet (direction 1)	Post-Project Segement Peak Hr V/C (direction 1)	0.376	0.40						0.18						
		Input value from updated Mobility Index spreadsheet (direction 2)	Post-Project Segement Peak Hr V/C (direction 2)	0.372	0.39						0.15						
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Peak Hr V/C (direction 1)	0.376	0.400	0.000	0.000	0.000	0.000	0.000	0.183	0.000		0.000	0.000	0.000	0.000
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Peak Hr V/C (direction 2)	0.372	0.390	0.000	0.000	0.000	0.000	0.000	0.149	0.000		0.000	0.000	0.000	0.000
	TTI AND PTI	Calculated Value (both directions)	Safety Reduction Factor	0.745	0.824	0.515	0.779	0.855	0.872	0.885	0.703	0.867	0.994	0.840	0.885	0.833	0.944
		Calculated Value (both directions)	Safety Reduction	0.255	0.176	0.485	0.221	0.145	0.128	0.115	0.297	0.133	0.006	0.160	0.115	0.167	0.056
		Calculated Value (both directions)	Mobility Reduction Factor	0.968	1.000	1.000	1.000	1.000	1.000	1.000	0.952	1.000	1.000	1.000	1.000	1.000	1.000
		Calculated Value (both directions)	Mobility Reduction	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.048	0.000	0.000	0.000	0.000	0.000	0.000
		Input current value from performance system (direction 1)	Original Directional Segment TTI (direction 1)	1.010	1.010		1.010	1.010	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000
		Input current value from performance system (direction 1)	Original Directional Segment PTI (direction 1)	1.130	1.130	1.130	1.130	1.130	1.210	1.210	1.210	1.210	1.210	1.230	1.230	1.230	1.230
		Input current value from performance system (direction 2)	Original Directional Segment TTI (direction 2)	1.030	1.030		1.030	1.030	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000
		Input current value from performance system (direction 2)	Original Directional Segment PTI (direction 2)	1.200	1.200	1.200	1.200	1.200	1.310	1.310	1.310	1.310	1.310	1.260	1.260	1.260	1.260
		Calculated Value (both directions)	Reduction Factor for Segment TTI	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.014	0.000	0.000	0.000	0.000	0.000	0.000
		Calculated Value (both directions)	Reduction Factor for Segment PTI	0.083	0.053	0.145	0.066	0.043	0.038	0.034	0.099	0.040	0.002	0.048	0.035	0.050	0.017
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 1)	Post-Project Directional Segment TTI (direction 1)	1.000	1.010	0.500	1.010	1.010	1.000	1.000	1.000	1.000	0.500	1.000	1.000	1.000	1.000
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 1)	Post-Project Directional Segment PTI (direction 1)	1.036	1.070	1.065	1.055	1.081	1.164	1.168	1.091	1.162	1.208	1.171	1.187	1.168	1.209
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 2)	Post-Project Directional Segment TTTI (direction 2)	1.020	1.030	0.500	1.030	1.030	1.000	1.000	1.000	1.000	0.000	1.000	1.000	1.000	1.000
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 2)	Post-Project Directional Segment TPTI (direction 2)	1.100	1.137	1.026	1.120	1.148	1.260	1.265	1.181	1.258	1.31	1.200	1.216	1.197	1.239
	CLOSURE EXTENT	Input current value from performance system (direction 1)	Orig Segment Directional Closure Extent (direction 1)	0.630	0.630	0.630	0.630	0.630	0.540	0.540	0.540	0.540	0.540	0.510	0.510	0.510	0.510
		Input current value from performance system (direction 2)	Orig Segment Directional Closure Extent (direction 2)	0.170	0.170	0.170	0.170	0.170	0.200	0.200	0.200	0.200	0.200	0.110	0.110	0.110	0.110
		Input value from HCRS	Segment Closures with fatalities/injuries	10	10	10	10	10	14	14	14	14	14	17	17	17	17
		Input value from HCRS	Total Segment Closures	14	14	14	14	14	19	19	19	19	19	26	26	26	26
		Calculated Value (both directions)	% Closures with Fatality/Injury	0.71	0.71	0.71	0.71	0.71	0.74	0.74	0.74	0.74	0.74	0.65	0.65	0.65	0.65
		Calculated Value (both directions)	Closure Reduction	0.182	0.126	0.346	0.158	0.103	0.094	0.084	0.219	0.098	0.004	0.105	0.075	0.109	0.036
		Calculated Value (both directions)	Closure Reduction Factor	0.818	0.874	0.654	0.842	0.897	0.906	0.916	0.781	0.902	0.996	0.895	0.925	0.891	0.964
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 1)	Post-Project Segment Directional Closure Extent (direction 1)	0.515	0.551	0.412	0.530	0.565	0.489	0.494	0.422	0.487	0.538	0.457	0.472	0.454	0.491
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction	Post-Project Segment Directional Closure Extent (direction 2)	0.139	0.149	0.111	0.143	0.152	0.181	0.183	0.156	0.180	0.200	0.099	0.102	0.098	0.106

			Solution #	40.3	40.4	40.5	40.6	40.7-A	40.7-B	40.08	40.9	40.10	40.11	40.12	40.13	40.14	40.15
FREIGHT	BICYCLE ACCOM	2)															
		Input current value from performance system	Orig Segment Bicycle Accomodation %	100.0%	100.0%		100.0%	100.0%	100.0%								
		Input current value from performance system	Orig Segment Outside Shoulder width	10	10		10	10	10								
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Outside Shoulder width		10												
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Bicycle Accommodation (%)		100.0%												
		Enter in Mobility Needs spreadsheet to calculate new segment level Mobility Need	Post-Project Segment Bicycle Accommodation (%)	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	0.0%	0.0%
	Needs	User entered value from Mobility Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Mobility Need	1.326	1.326	1.326	1.326	1.326	0.745	0.745	0.745	0.745	0.745	1.063	1.063	1.063	1.063
		User entered value from Mobility Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Mobility Need	1.213	1.289	1.200	1.279	1.296	0.719	0.722	0.642	0.718	0.744	1.026	1.038	1.023	1.053
	TTTI AND TPTI	Input current value from performance system (direction 1)	Original Directional Segment TTTI (direction 1)	1.050	1.050	1.050	1.050	1.050	1.020	1.020	1.020	1.020	1.020				
		Input current value from performance system (direction 1)	Original Directional Segment TPTI (direction 1)	1.160	1.160	1.160	1.160	1.160	1.100	1.100	1.100	1.100	1.100	1.120	1.120	1.120	1.120
		Input current value from performance system (direction 2)	Original Directional Segment TTTI (direction 2)	1.080	1.080	1.080	1.080	1.080	1.060	1.060	1.060	1.060	1.060				
		Input current value from performance system (direction 2)	Original Directional Segment TPTI (direction 2)	1.210	1.210	1.210	1.210	1.210	1.160	1.160	1.160	1.160	1.160	1.130	1.130	1.130	1.130
		Calculated Value (both directions)	Reduction Factor for Segment TTTI (both directions)	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.000	0.000	0.000
		Calculated Value (both directions)	Reduction Factor for Segment TPTI (both directions)	0.042	0.026	0.073	0.033	0.022	0.019	0.017	0.049	0.020	0.001	0.024	0.017	0.025	0.008
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 1)	Post-Project Directional Segment TTTI (direction 1)	1.045	1.050	1.050	1.050	1.050	1.020	1.020	1.013	1.020	1.020	0.000	0.000	0.000	0.000
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 1)	Post-Project Directional Segment TPTI (direction 1)	1.112	1.129	1.076	1.122	1.135	1.079	1.081	1.046	1.078	1.099	1.093	1.101	1.092	1.111
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 2)	Post-Project Directional Segment TTTI (direction 2)	1.075	1.080	1.080	1.080	1.080	1.060	1.060	1.052	1.060	1.060	0.500	0.500	0.500	0.500
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 2)	Post-Project Directional Segment TPTI (direction 2)	1.160	1.178	1.122	1.170	1.184	1.138	1.140	1.103	1.137	1.160	1.103	1.110	1.102	1.121
	FREIGHT INDEX	Value from above	Original Segment TPTI (direction 1)	1.160	1.160	1.160	1.160	1.160	1.100	1.100	1.100	1.100	1.100	1.120	1.120	1.120	1.120
		Value from above	Original Segment TPTI (direction 2)	1.210	1.210	1.210	1.210	1.210	1.160	1.160	1.160	1.160	1.160	1.130	1.130	1.130	1.130
		Calculated Value	Original Segment Freight Index	0.844	0.844	0.844	0.844	0.844	0.885	0.885	0.885	0.885	0.885	0.889	0.889	0.889	0.889
		Calculated Value	Post-Project Segment TPTI (direction 1)	1.112	1.129	1.076	1.122	1.135	1.079	1.081	1.046	1.078	1.099	1.093	1.101	1.092	1.111
		Calculated Value	Post-Project Segment TPTI (direction 2)	1.160	1.178	1.122	1.170	1.184	1.138	1.140	1.103	1.137	1.160	1.103	1.110	1.102	1.121
		Enter in Freight Needs spreadsheet to update segment level Freight Need	Post-Project Segment Freight Index	0.880	0.867	0.910	0.873	0.863	0.902	0.900	0.931	0.903	0.885	0.911	0.905	0.912	0.896
	CLOSURE DURATION	Input current value from performance system (direction 1)	Orig Segment Directional Closure Duration (dir 1)	240.700	240.700	240.700	240.700	240.700	211.460	211.460	211.460	211.460	211.460	219.430	219.430	219.430	219.430
		Input current value from performance system (direction 2)	Orig Segment Directional Closure Duration (dir 2)	21.100	21.100	21.100	21.100	21.100	76.440	76.440	76.440	76.440	76.440	26.300	26.300	26.300	26.300
		Calculated Value	Segment Closures with fatalities	10	10	10	10	10	14	14	14	14	14	17	17	17	17
		Calculated Value	Total Segment Closures	14	14	14	14	14	19	19	19	19	19	26	26	26	26
		Calculated Value	% Closures with Fatality	0.71	0.71	0.71	0.71	0.71	0.74	0.74	0.74	0.74	0.74	0.65	0.65	0.65	0.65
		Calculated Value	Closure Reduction	0.182	0.126	0.346	0.158	0.103	0.094	0.084	0.219	0.098	0.004	0.105	0.075	0.109	0.036

		Solution #		40.3	40.4	40.5	40.6	40.7-A	40.7-B	40.08	40.9	40.10	40.11	40.12	40.13	40.14	40.15
BRIDGE		Calculated Value	Closure Reduction Factor	0.818	0.874	0.654	0.842	0.897	0.906	0.916	0.781	0.902	0.996	0.895	0.925	0.891	0.964
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 1)	Post-Project Segment Directional Closure Duration (direction 1)	196.829	210.463	157.389	202.672	215.819	191.550	193.615	165.113	190.724	210.551	196.496	202.896	195.429	211.430
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 2)	Post-Project Segment Directional Closure Duration (direction 2)	17.254	18.449	13.797	17.766	18.919	69.243	69.989	59.686	68.944	76.440	23.551	24.318	23.423	25.341
	VERT CLR	Input current value from performance system	Original Segment Vertical Clearance														
		Input current value from performance system	Original vertical clearance for specific bridge														
		Input post-project value (depends on solution)	Post-Project vertical clearance for specific bridge														
		Input post-project value (depends on solution)(force segment clearance to equal this specific bridge)	Post-Project Segment Vertical Clearance														
		Enter in Freight Needs spreadsheet to update segment level Freight Need	Post-Project Segment Vertical Clearance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00
	Needs	User entered value from Freight Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Freight Need	0.829	0.829		0.829	0.829	0.982	0.982	0.982	0.982	0.982	0.607	0.607	0.607	0.607
		User entered value from Freight Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Freight Need	0.741	0.769		0.753	0.779	0.922	0.947	0.863	0.920	0.98	0.56	0.573	0.558	0.59
	BRIDGE INDEX	Input current value from performance system	Original Segment Bridge Index														
		Input current value from performance system	Original lowest rating for specific bridge														
		Input post-project value (For repair +1, rehab +2, replace=8)	Post-Project lowest rating for specific bridge														
		Enter in Bridge Index spreadsheet to calculate new Bridge Index	Post-Project lowest rating for specific bridge	0	0	0	0	0	0		0			0	0	0	0
		Input updated segment value from updated Bridge Index spreadsheet	Post-Project Segment Bridge Index														
		Enter in Bridge Needs spreadsheet to update segment level Bridge Need	Post-Project Segment Bridge Index	0.00	0.00	0.00	0.00	0.00	0.00		0.00			0.00	0.00	0.00	0.00
	SUFF RATING	Input current value from performance system	Original Segment Sufficiency Rating														
		Input current value from performance system	Original Sufficiency Rating for specific bridge														
		Input post-project value (For repair +10, rehab +20, replace=98)	Post-Project Sufficiency Rating for specific bridge														
		Enter in Bridge Index spreadsheet to calculate new Bridge Index	Post-Project Sufficiency Rating for specific bridge	0.00	0.00	0.00	0.00	0.00	0.00		0.00			0.00	0.00	0.00	0.00
		Input updated segment value from updated Bridge Index spreadsheet	Post-Project Segment Sufficiency Rating														
		Enter in Bridge Needs spreadsheet to update segment level Bridge Need	Post-Project Segment Sufficiency Rating	0.00	0.00	0.00	0.00	0.00	0.00		0.00			0.00	0.00	0.00	0.00
	BR RTNG	Input current value from performance system	Original Segment Bridge Rating														
		Input updated segment value from updated Bridge Index spreadsheet	Post-Project Segment Bridge Rating														
		Enter in Bridge Needs spreadsheet to update segment level Bridge Need	Post-Project Segment Bridge Rating	0	0	0	0	0	0		0			0	0	0	0
	% FUN OB	Input current value from performance system	Original Segment % Functionally Obsolete														
		Input updated value from updated Bridge Index spreadsheet (only remove bridge from FO if replace or rehab)	Post-Project Segment % Functionally Obsolete														

		Solution #		40.3	40.4	40.5	40.6	40.7-A	40.7-B	40.08	40.9	40.10	40.11	40.12	40.13	40.14	40.15
		Enter in Bridge Needs spreadsheet to update segment level Bridge Need	Post-Project Segment % Functionally Obsolete	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		0.00%			0.00%	0.00%	0.00%	0.00%
	Needs	User entered value from Bridge Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Bridge Need														
		User entered value from Bridge Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Bridge Need														
PAVEMENT	PAVEMENT INDEX	Input current value from performance system	Original Segment Pavement Index										3.83				
		Input current value from performance system	Original Segment IRI in project limits										100				
		Input current value from performance system	Original Segment Cracking in project limits										0				
		Input post-project value (For rehab, increase to 45; for replace increase to 30)	Post-Project IRI in project limits										45				
		Enter in Pavement Index spreadsheet to calculate new Pavement Index	Post-Project IRI in project limits	0	0	0	0	0	0		0		45	0	0	0	0
		Input post-project value (Lower to 0 for rehab or replace)	Post-Project Cracking in project limits										0				
		Enter in Pavement Index spreadsheet to calculate new Pavement Index	Post-Project Cracking in project limits	0	0	0	0	0	0		0		0	0	0	0	0
		Input updated segment value from updated Pavement Index spreadsheet	Post-Project Segment Pavement Index										3.91				
		Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment Pavement Index	0	0	0	0	0	0		0		3.91	0	0	0	0
	DIRECTION PSR	Input current value from performance system (direction 1)	Original Segment Directional PSR (direction 1)										3.47				
		Input current value from performance system (direction 2)	Original Segment Directional PSR (direction 2)										3.85				
		Value from above	Original Segment IRI in project limits	0	0	0	0	0	0		0		100	0	0	0	0
		Value from above	Post-Project directional IRI in project limits	0	0	0	0	0	0		0		45	0	0	0	0
		Input updated segment value from updated Pavement Index spreadsheet (direction 1)	Post-Project Segment Directional PSR (direction 1)										3.71				
		Input updated segment value from updated Pavement Index spreadsheet (direction 2)	Post-Project Segment Directional PSR (direction 2)										3.85				
		Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment Directional PSR (direction 1)	0	0	0	0	0	0		0		3.71	0	0	0	0
		Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment Directional PSR (direction 2)	0	0	0	0	0	0		0		3.85	0	0	0	0
	% FAIL	Input current value from performance system	Original Segment % Failure										25.0%				
		Input value from updated Pavement Index spreadsheet	Post-Project Segment % Failure										20.0%				
		Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment % Failure	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		0.0%		20.0%	0.0%	0.0%	0.0%	0.0%
	Needs	User entered value from Pavement Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Pavement Need										0.603				

				Solution #	40.3	40.4	40.5	40.6	40.7-A	40.7-B	40.08	40.9	40.10	40.11	40.12	40.13	40.14	40.15
		User entered value from Pavement Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Pavement Need											0.413				

LEGEND:



- user entered value



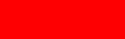
- calculated value for reference only



- calculated value for entry/use in other spreadsheet



- for input into Performance Effectiveness Score spreadsheet



- assumed values (do not modify)

Solution #	40.17	40.24	40.25	40.26
	East Winslow	Lupton West	Lupton East	Lupton TI's
Description				
Project Beg MP	258	345	351	347.5
Project End MP	266	351	360	359.5
Project Length (miles)	8	6	9	12
Segment Beg MP	258	342	342	342
Segment End MP	270	360	360	360
Segment Length (miles)	12	18	18	18
Segment #	6	12	12	12
Current # of Lanes (both directions)	4	4	4	4
Project Type (one-way or two-way)	two-way	two-way	two-way	two-way
Additional Lanes (one-way)	0	0	0	0
Pro-Rated # of Lanes	4.00	4.00	4.00	4.00

		Notes and Directions	Description				
SAFETY	DIRECTIONAL SAFETY	Input current value from performance system (direction 1)	Orig Segment Directional Safety Index (direction 1)	1.160	1.770	1.770	1.770
		Input current value from performance system (direction 1)	Orig Segment Directional Fatal Crashes (direction 1)	2	5	5	5
		Input current value from performance system (direction 1)	Orig Segment Directional Incap Crashes (direction 1)	4	3	3	3
		Input current value from performance system (direction 1)	Original Fatal Crashes in project limits (direction 1)	1	3	1	1
		Input current value from performance system (direction 1)	Original Incap Crashes in project limits (direction 1)	3	1	2	1
		Input CMF value (direction 1) - If no CMF enter 1.0	CMF 1 (direction 1)			0.77	0.21
		Input CMF value (direction 1) - If no CMF enter 1.0	CMF 2 (direction 1)			0.87	1
						1	1
		Input CMF value (direction 1) - If no CMF enter 1.0	CMF 3 (direction 1)			1	1
		Calculated Value (direction 1)	Total CMF (direction 1)	0.500	0.500	0.720	0.210
		Calculated Value (direction 1)	Fatal Crash reduction (direction 1)	0.500	1.500	0.280	0.790
		Calculated Value (direction 1)	Incap Crash reduction (direction 1)	1.500	0.500	0.560	0.790
		Enter in Safety Index spreadsheet to calculate new Safety Index (direction 1)	Post-Project Segment Directional Fatal Crashes (direction 1)	1.554	3.936	4.720	4.210
		Enter in Safety Index spreadsheet to calculate new Safety Index (direction 1)	Post-Project Segment Directional Incap Crashes (direction 1)	3.160	2.496	2.440	2.210
		Input value from updated Safety Index spreadsheet (direction 1)	Post-Project Segment Directional Safety Index (direction 1)	0.900	1.400	1.670	1.490
		Enter in Safety Needs spreadsheet to calculate new segment level Safety Need (direction 1)	Post-Project Segment Directional Safety Index (direction 1)	0.900	1.400	1.670	1.490
		Input current value from performance system (direction 2)	Orig Segment Directional Safety Index (direction 2)	1.130	0.710	0.710	0.710
		Input current value from performance system (direction 2)	Orig Segment Directional Fatal Crashes (direction 2)	2	2	2	2
		Input current value from performance system (direction 2)	Orig Segment Directional Incap Crashes (direction 2)	3	1	1	1
		Input current value from performance system (direction 2)	Original Fatal Crashes in project limits (direction 2)	2	0	2	0
		Input current value from performance system (direction 2)	Original Incap Crashes in project limits (direction 2)	2	1	0	1
		Input CMF value (direction 2) - If no CMF enter 1.0	CMF 1 (direction 2)		0.67	0.77	0.21

		Input CMF value (direction 2) - If no CMF enter 1.0	CMF 1 (direction 2)		0.77	0.87	1
					0.79	1	1
		Input CMF value (direction 2) - If no CMF enter 1.0	CMF 1 (direction 2)		0.87	1	1
		Calculated Value (direction 2)	Total CMF (direction 2)	0.500	0.500	0.720	0.210
		Calculated Value (direction 2)	Fatal Crash reduction (direction 2)	1.000	0.000	0.560	0.000
		Calculated Value (direction 2)	Incap Crash reduction (direction 2)	1.000	0.500	0.000	0.790
		Enter in Safety Index spreadsheet to calculate new Safety Index (direction 2)	Post-Project Segment Directional Fatal Crashes (direction 2)	1.274	2.000	1.440	2.000
		Enter in Safety Index spreadsheet to calculate new Safety Index (direction 2)	Post-Project Segment Directional Incap Crashes (direction 2)	2.274	0.720	1.000	0.210
		Input value from updated Safety Index spreadsheet (direction 2)	Post-Project Segment Directional Safety Index (direction 2)	0.730	0.700	0.520	0.690
		Enter in Safety Needs spreadsheet to calculate new segment level Safety Need (direction 2)	Post-Project Segment Directional Safety Index (direction 2)	0.730	0.700	0.520	0.690
	SAFETY INDEX	Calculated Value - verify that it matches current performance system	Current Safety Index	1.145	1.240	1.240	1.240
		Enter in Safety Needs spreadsheet to calculate new segment level Safety Need	Post-Project Safety Index	0.815	1.050	1.095	1.090
	Needs	User entered value from Safety Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Safety Need	2.269	2.292	2.292	2.292
		User entered value from Safety Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Safety Need	0.837	1.552	1.854	1.799
MOBILITY	MOBILITY INDEX	Input current value from performance system	Original Segment Mobility Index	0.390	0.470	0.470	0.470
		Enter in Mobility Index Spreadsheet to determine new segment level Mobility Index	Post-Project # of Lanes (both directions)	4.00	4.00	4.00	4.00
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Mobility Index	0.39	0.47	0.47	0.47
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Mobility Index	0.390	0.470	0.470	0.470
	FUT V/C	Input current value from performance system	Original Segment Future V/C				
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Future V/C				
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Future V/C	0.000	0.000	0.000	0.000
	PEAK HOUR V/C	Input current value from performance system (direction 1)	Original Segment Peak Hour V/C (direction 1)				
		Input current value from performance system (direction 2)	Original Segment Peak Hour V/C (direction 2)				
		*If One-Way project, enter in Mobility Index Spreadsheet to determine new segment level Peak Hour V/C. If Two-Way project, disregard	Adjusted total # of Lanes for use in directional peak hr	N/A	N/A	N/A	N/A
		Input value from updated Mobility Index spreadsheet (direction 1)	Post-Project Segement Peak Hr V/C (direction 1)				
		Input value from updated Mobility Index spreadsheet (direction 2)	Post-Project Segement Peak Hr V/C (direction 2)				
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Peak Hr V/C (direction 1)	0.000	0.000	0.000	0.000
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Peak Hr V/C (direction 2)	0.000	0.000	0.000	0.000

FREIGHT	TTI AND PTI	Calculated Value (both directions)	Safety Reduction Factor	0.712	0.847	0.883	0.879
		Calculated Value (both directions)	Safety Reduction	0.288	0.153	0.117	0.121
		Calculated Value (both directions)	Mobility Reduction Factor	1.000	1.000	1.000	1.000
		Calculated Value (both directions)	Mobility Reduction	0.000	0.000	0.000	0.000
		Input current value from performance system (direction 1)	Original Directional Segment TTI (direction 1)				
		Input current value from performance system (direction 1)	Original Directional Segment PTI (direction 1)	1.200	1.240	1.240	1.240
		Input current value from performance system (direction 2)	Original Directional Segment TTI (direction 2)				
		Input current value from performance system (direction 2)	Original Directional Segment PTI (direction 2)	1.190	1.300	1.300	1.300
		Calculated Value (both directions)	Reduction Factor for Segment TTI	0.000	0.000	0.000	0.000
		Calculated Value (both directions)	Reduction Factor for Segment PTI	0.086	0.046	0.035	0.036
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 1)	Post-Project Directional Segment TTI (direction 1)	0.500	0.500	0.500	0.500
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 1)	Post-Project Directional Segment PTI (direction 1)	1.096	1.183	1.197	1.195
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 2)	Post-Project Directional Segment TTTI (direction 2)	0.500	0.500	0.500	0.500
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 2)	Post-Project Directional Segment TPTI (direction 2)	1.087	1.24	1.254	1.253
	CLOSURE EXTENT	Input current value from performance system (direction 1)	Orig Segment Directional Closure Extent (direction 1)	0.110	0.110	0.110	0.110
		Input current value from performance system (direction 2)	Orig Segment Directional Closure Extent (direction 2)	0.000	0.110	0.110	0.110
		Input value from HCRS	Segment Closures with fatalities/injuries	3	9	9	9
		Input value from HCRS	Total Segment Closures	6	17	17	17
		Calculated Value (both directions)	% Closures with Fatality/Injury	0.50	0.53	0.53	0.53
		Calculated Value (both directions)	Closure Reduction	0.144	0.081	0.062	0.064
		Calculated Value (both directions)	Closure Reduction Factor	0.856	0.919	0.938	0.936
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 1)	Post-Project Segment Directional Closure Extent (direction 1)	0.094	0.101	0.103	0.103
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 2)	Post-Project Segment Directional Closure Extent (direction 2)	0.000	0.101	0.103	0.103
	BICYCLE ACCOM	Input current value from performance system	Orig Segment Bicycle Accomodation %				
		Input current value from performance system	Orig Segment Outside Shoulder width				
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Outside Shoulder width				
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Bicycle Accomodation (%)				
		Enter in Mobility Needs spreadsheet to calculate new segment level Mobility Need	Post-Project Segment Bicycle Accomodation (%)	0.0%	0.0%	0.0%	0.0%
	Needs	User entered value from Mobility Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Mobility Need	0.609	0.810	0.810	0.810
		User entered value from Mobility Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Mobility Need	0.599	0.807	0.803	0.804
	TTTI AND TPTI	Input current value from performance system (direction 1)	Original Directional Segment TTTI (direction 1)				
		Input current value from performance system (direction 1)	Original Directional Segment TPTI (direction 1)	1.110	1.130	1.130	1.130
		Input current value from performance system (direction 2)	Original Directional Segment TTTI (direction 2)				
		Input current value from performance system (direction 2)	Original Directional Segment TPTI (direction 2)	1.090	1.150	1.150	1.150
		Calculated Value (both directions)	Reduction Factor for Segment TTTI (both directions)	0.000	0.000	0.000	0.000
		Calculated Value (both directions)	Reduction Factor for Segment TPTI (both directions)	0.043	0.023	0.018	0.018

BRIDGE	FREIGHT INDEX	Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 1)	Post-Project Directional Segment TTTI (direction 1)	0.000	0.000	0.000	0.000
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 1)	Post-Project Directional Segment TPTI (direction 1)	1.062	1.104	1.110	1.109
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 2)	Post-Project Directional Segment TTTI (direction 2)	0.500	0.500	0.500	0.500
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 2)	Post-Project Directional Segment TPTI (direction 2)	1.043	1.124	1.130	1.129
		Value from above	Original Segment TPTI (direction 1)	1.110	1.130	1.130	1.130
		Value from above	Original Segment TPTI (direction 2)	1.090	1.150	1.150	1.150
		Calculated Value	Original Segment Freight Index	0.909	0.877	0.877	0.877
		Calculated Value	Post-Project Segment TPTI (direction 1)	1.062	1.104	1.110	1.109
		Calculated Value	Post-Project Segment TPTI (direction 2)	1.043	1.124	1.130	1.129
		Enter in Freight Needs spreadsheet to update segment level Freight Need	Post-Project Segment Freight Index	0.950	0.898	0.893	0.893
	CLOSURE DURATION	Input current value from performance system (direction 1)	Orig Segment Directional Closure Duration (dir 1)	23.770	25.540	25.540	25.540
		Input current value from performance system (direction 2)	Orig Segment Directional Closure Duration (dir 2)	0.000	36.650	36.650	36.650
		Calculated Value	Segment Closures with fatalities	3	9	9	9
		Calculated Value	Total Segment Closures	6	17	17	17
		Calculated Value	% Closures with Fatality	0.50	0.53	0.53	0.53
		Calculated Value	Closure Reduction	0.144	0.081	0.062	0.064
		Calculated Value	Closure Reduction Factor	0.856	0.919	0.938	0.936
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 1)	Post-Project Segment Directional Closure Duration (direction 1)	20.345	23.468	23.959	23.904
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 2)	Post-Project Segment Directional Closure Duration (direction 2)	0.000	33.677	34.381	34.303
		Enter in Freight Needs spreadsheet to update segment level Freight Need	Post-Project Segment Freight Index	0.950	0.898	0.893	0.893
	VERT CLR	Input current value from performance system	Original Segment Vertical Clearance				
		Input current value from performance system	Original vertical clearance for specific bridge				
		Input post-project value (depends on solution)	Post-Project vertical clearance for specific bridge				
		Input post-project value (depends on solution)(force segment clearance to equal this specific bridge)	Post-Project Segment Vertical Clearance				
		Enter in Freight Needs spreadsheet to update segment level Freight Need	Post-Project Segment Vertical Clearance	0.00	0.00	0.00	0.00
		Enter in Freight Needs spreadsheet to update segment level Freight Need	Post-Project Segment Freight Index	0.950	0.898	0.893	0.893
	Needs	User entered value from Freight Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Freight Need	0.182	0.577	0.577	0.577
		User entered value from Freight Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Freight Need	0.176	0.571	0.573	0.572
	BRIDGE INDEX	Input current value from performance system	Original Segment Bridge Index				
		Input current value from performance system	Original lowest rating for specific bridge				
		Input post-project value (For repair +1, rehab +2, replace=8)	Post-Project lowest rating for specific bridge				
		Enter in Bridge Index spreadsheet to calculate new Bridge Index	Post-Project lowest rating for specific bridge	0	0	0	0
		Input updated segment value from updated Bridge Index spreadsheet	Post-Project Segment Bridge Index				
		Enter in Bridge Needs spreadsheet to update segment level Bridge Need	Post-Project Segment Bridge Index	0.00	0.00	0.00	0.00
	SUFF RATING	Input current value from performance system	Original Segment Sufficiency Rating				
		Input current value from performance system	Original Sufficiency Rating for specific bridge				
		Input post-project value (For repair +10, rehab +20, replace=98)	Post-Project Sufficiency Rating for specific bridge				
		Enter in Bridge Index spreadsheet to calculate new Bridge Index	Post-Project Sufficiency Rating for specific bridge	0.00	0.00	0.00	0.00
		Input updated segment value from updated Bridge Index spreadsheet	Post-Project Segment Sufficiency Rating				

		Enter in Bridge Needs spreadsheet to update segment level Bridge Need	Post-Project Segment Sufficiency Rating	0.00	0.00	0.00	0.00
	BR RTNG	Input current value from performance system	Original Segment Bridge Rating				
		Input updated segment value from updated Bridge Index spreadsheet	Post-Project Segment Bridge Rating				
		Enter in Bridge Needs spreadsheet to update segment level Bridge Need	Post-Project Segment Bridge Rating	0	0	0	0
	% FUN OB	Input current value from performance system	Original Segment % Functionally Obsolete				
		Input updated value from updated Bridge Index spreadsheet (only remove bridge from FO if replace or rehab)	Post-Project Segment % Functionally Obsolete				
		Enter in Bridge Needs spreadsheet to update segment level Bridge Need	Post-Project Segment % Functionally Obsolete	0.00%	0.00%	0.00%	0.00%
	Needs	User entered value from Bridge Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Bridge Need				
		User entered value from Bridge Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Bridge Need				
PAVEMENT	PAVEMENT INDEX	Input current value from performance system	Original Segment Pavement Index				
		Input current value from performance system	Original Segment IRI in project limits				
		Input current value from performance system	Original Segment Cracking in project limits				
		Input post-project value (For rehab, increase to 45; for replace increase to 30)	Post-Project IRI in project limits				
		Enter in Pavement Index spreadsheet to calculate new Pavement Index	Post-Project IRI in project limits	0	0	0	0
		Input post-project value (Lower to 0 for rehab or replace)	Post-Project Cracking in project limits				
		Enter in Pavement Index spreadsheet to calculate new Pavement Index	Post-Project Cracking in project limits	0	0	0	0
		Input updated segment value from updated Pavement Index spreadsheet	Post-Project Segment Pavement Index				
		Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment Pavement Index	0	0	0	0
	DIRECTION PSR	Input current value from performance system (direction 1)	Original Segment Directional PSR (direction 1)				
		Input current value from performance system (direction 2)	Original Segment Directional PSR (direction 2)				
		Value from above	Original Segment IRI in project limits	0	0	0	0
		Value from above	Post-Project directional IRI in project limits	0	0	0	0
		Input updated segment value from updated Pavement Index spreadsheet (direction 1)	Post-Project Segment Directional PSR (direction 1)				
		Input updated segment value from updated Pavement Index spreadsheet (direction 2)	Post-Project Segment Directional PSR (direction 2)				
		Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment Directional PSR (direction 1)	0	0	0	0
		Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment Directional PSR (direction 2)	0	0	0	0
	% FAIL	Input current value from performance system	Original Segment % Failure				
		Input value from updated Pavement Index spreadsheet	Post-Project Segment % Failure				
		Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment % Failure	0.0%	0.0%	0.0%	0.0%
	Needs	User entered value from Pavement Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Pavement Need				
		User entered value from Pavement Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Pavement Need				

Performance Area Scoring

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost (\$ millions)	Pavement					Bridge					Safety					Mobility					Freight				
				Existing Need	Post- Solution Need	Raw Score	Risk Factor	Factored Score	Existing Need	Post- Solution Need	Raw Score	Risk Factor	Factored Score	Existing Need	Post- Solution Need	Raw Score	Risk Factor	Factored Score	Existing Need	Post- Solution Need	Raw Score	Risk Factor	Factored Score	Existing Need	Post- Solution Need	Raw Score	Risk Factor	Factored Score
40.03	Flagstaff Safety	196-200	10.2			0.000		0.000			0.000		0.000	5.296	3.350	1.946	2.75	5.352	1.326	1.213	0.113	3.07	0.347	0.829	0.741	0.088	2.94	0.259
40.04	Lighting	196-202	8.06			0.000		0.000			0.000		0.000	5.296	3.932	1.364	2.75	3.751	1.326	1.289	0.037	3.26	0.121	0.829	0.769	0.060	2.94	0.176
40.05	Ped Improve		2.82			0.000		0.000			0.000		0.000	5.296	1.198	4.098	2.75	11.270	1.326	1.200	0.126	2.52	0.318	0.829	0.663	0.166	2.94	0.488
40.06	Butler TI	198.5- 199.5	4.43			0.000		0.000			0.000		0.000	5.296	3.067	2.229	2.71	6.041	1.326	1.279	0.047	1.91	0.090	0.829	0.753	0.076	2.94	0.223
40.07	East Flagstaff (Composite)	200-207	23.58					0.000					0.000					5.067					0.228					0.446
40.7-A	East Flagstaff	200-202	11.61			0.000		0.000			0.000		0.000	5.296	4.179	1.117	2.70	3.016	1.326	1.296	0.030	2.52	0.076	0.829	0.779	0.050	2.94	0.147
40.7-B	East Flagstaff	202-207	11.97			0.000		0.000			0.000		0.000	4.964	4.150	0.814	2.52	2.051	0.745	0.719	0.026	5.88	0.153	0.982	0.922	0.060	4.99	0.299
40.08	TI Lighting	204.5- 207.5	0.99			0.000		0.000			0.000		0.000	4.964	4.228	0.736	2.47	1.818	0.745	0.722	0.023	5.08	0.117	0.982	0.947	0.035	4.99	0.175
40.09	Winona Safety	207-212	22.21			0.000		0.000			0.000		0.000	4.964	3.072	1.892	2.04	3.860	0.745	0.642	0.103	5.88	0.606	0.982	0.863	0.119	4.99	0.594
40.10	Country Club & Walnut Canyon	201.5- 205.5	8.85			0.000		0.000			0.000		0.000	4.964	4.117	0.847	2.52	2.134	0.745	0.718	0.027	5.68	0.153	0.982	0.920	0.062	4.99	0.309
40.11	Pavement	202-205	12.92	0.603	0.413	0.190	6.25	1.188			0.000		0.000	4.964	4.917	0.047	2.16	0.102	0.745	0.744	0.001	5.42	0.005	0.982	0.980	0.002	4.99	0.010
40.12	Canyon Diablo West Curves	218-220	10.05			0.000		0.000			0.000		0.000	3.164	2.431	0.733	1.72	1.261	1.063	1.026	0.037	4.70	0.174	0.607	0.560	0.047	4.81	0.226
40.13	Canyon Diablo Middle	220-229	13.95			0.000		0.000			0.000		0.000	3.164	2.617	0.547	1.67	0.913	1.063	1.038	0.025	5.97	0.149	0.607	0.573	0.034	4.81	0.164
40.14	Twin Arrows TI	219.5- 220.5	4.43			0.000		0.000			0.000		0.000	3.164	2.375	0.789	1.68	1.326	1.063	1.023	0.040	4.30	0.172	0.607	0.558	0.049	4.81	0.236
40.15	Canyon Diablo East Curves	229-230	5.09			0.000		0.000			0.000		0.000	3.164	2.900	0.264	1.54	0.407	1.063	1.053	0.010	4.30	0.043	0.607	0.590	0.017	4.81	40.15
40.17	East Winslow	258-266	10.86			0.000		0.000			0.000		0.000	2.269	0.837	1.432	1.32	1.890	0.609	0.599	0.010	5.58	0.056	0.182	0.176	0.006	4.87	0.029
40.24	Lupton West	345-351	11.86			0.000		0.000			0.000		0.000	2.292	1.552	0.740	2.41	1.783	0.810	0.807	0.003	3.34	0.010	0.577	0.571	0.006	2.59	0.016
40.25	Lupton East	351-360	4.6			0.000		0.000			0.000		0.000	2.292	1.854	0.438	1.80	0.788	0.810	0.803	0.007	3.66	0.026	0.577	0.573	0.004	2.59	0.010
40.26	Lupton TI's		9.96			0.000		0.000			0.000		0.000	2.292	1.799	0.493	2.46	1.213	0.810	0.804	0.006	2.72	0.016	0.577	0.572	0.005	2.59	0.013

Performance Effectiveness Scoring Results

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost (\$ millions)	Risk Factored Benefit Score					Risk Factored Emphasis Area Score			Total Factored Benefit Score	F _{VMT}	F _{NPV}	Performance Effectiveness Score
				Pavement	Bridge	Mobility	Safety	Freight	Safety	Pavement	Bridge				
40.03	Flagstaff Safety	196-200	10.2	0.000	0.000	0.347	5.352	0.259	0.037	0.000	0.000	5.99	4.38	15.3	39.4
40.04	Lighting	196-202	8.06	0.000	0.000	0.121	3.751	0.176	0.025	0.000	0.000	4.07	4.78	15.3	37.0
40.05	Ped Improve		2.82	0.000	0.000	0.318	11.270	0.488	0.070	0.000	0.000	12.08	0.61	20.2	53.4
40.06	Butler TI	198.5-199.5	4.43	0.000	0.000	0.090	6.041	0.223	0.028	0.000	0.000	6.38	1.15	20.2	33.5
40.07	East Flagstaff (Composite)	200-207	23.58	0.000	0.000	0.228	5.067	0.446	0.050	0.000	0.000	5.79	3.44	15.3	12.9
40.7-A	East Flagstaff	200-202	11.61	0.000	0.000	0.076	3.016	0.147	0.020	0.000	0.000				
40.7-B	East Flagstaff	202-207	11.97	0.000	0.000	0.153	2.051	0.299	0.030	0.000	0.000				
40.08	TI Lighting	204.5-207.5	0.99	0.000	0.000	0.117	1.818	0.175	0.033	0.000	0.000	2.14	1.16	15.3	38.5
40.09	Winona Safety	207-212	22.21	0.000	0.000	0.606	3.860	0.594	0.055	0.000	0.000	5.11	3.67	15.3	12.9
40.10	Country Club & Walnut Canyon	201.5-205.5	8.85	0.000	0.000	0.153	2.134	0.309	0.030	0.000	0.000	2.63	1.16	20.2	7.0
40.11	Pavement	202-205	12.92	1.188	0.000	0.005	0.102	0.010	0.000	0.056	0.000	1.36	1.65	15.3	2.7
40.12	Canyon Diablo West Curves	218-220	10.05	0.000	0.000	0.174	1.261	0.226	0.041	0.000	0.000	1.70	1.81	15.3	4.7
40.13	Canyon Diablo Middle	220-229	13.95	0.000	0.000	0.149	0.913	0.164	0.028	0.000	0.000	1.25	4.34	15.3	6.0
40.14	Twin Arrows TI	219.5-220.5	4.43	0.000	0.000	0.172	1.326	0.236	0.040	0.000	0.000	1.77	1.01	20.2	8.1
40.15	Canyon Diablo East Curves	229-230	5.09	0.000	0.000	0.043	0.407	40.15	0.012	0.000	0.000	0.54	1.01	15.3	1.6
40.17	East Winslow	258-266	10.86	0.000	0.000	0.056	1.890	0.029	0.026	0.000	0.000	2.00	4.17	15.3	11.7
40.24	Lupton West	345-351	11.86	0.000	0.000	0.010	1.783	0.016	0.040	0.000	0.000	1.85	3.68	15.3	8.8
40.25	Lupton East	351-360	4.6	0.000	0.000	0.026	0.788	0.010	0.022	0.000	0.000	0.85	4.33	15.3	12.2
40.26	Lupton TI's		9.96	0.000	0.000	0.016	1.213	0.013	0.030	0.000	0.000	1.27	1.21	20.2	3.1

Appendix F: Project Prioritization Scores

Performance Evaluation Risk Factors and Prioritization

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost (\$ millions)	Pavement		Bridge		Safety		Mobility		Freight		Total Factored Score	Risk Factors					Weighted Risk Factor	Segment Need	Prioritization Score
				Score	%	Score	%	Score	%	Score	%	Score	%		Pavement	Bridge	Safety	Mobility	Freight			
40.03	Flagstaff Safety	196-200	10.2	0.000	0.0%	0.000	0.0%	5.389	89.9%	0.347	5.8%	0.259	4.3%	5.994	1.14	1.51	1.78	1.36	1.36	1.738	1.23	84
40.04	Lighting	196-202	8.06	0.000	0.0%	0.000	0.0%	3.776	92.7%	0.121	3.0%	0.176	4.3%	4.073	1.14	1.51	1.78	1.36	1.36	1.749	1.23	80
40.05	Ped Safety	0	2.82	0.000	0.0%	0.000	0.0%	11.340	93.4%	0.318	2.6%	0.488	4.0%	12.145	1.14	1.51	1.78	1.36	1.36	1.752	1.23	115
40.06	Butler TI	198.5-199.5	4.43	0.000	0.0%	0.000	0.0%	6.069	95.1%	0.090	1.4%	0.223	3.5%	6.382	1.14	1.51	1.78	1.36	1.36	1.759	1.23	73
40.07	East Flagstaff	200-207	23.58	0.000	0.0%	0.000	0.0%	5.118	88.3%	0.228	3.9%	0.446	7.7%	5.793	1.14	1.51	1.78	1.36	1.36	1.718	1.39	31
40.08	TI Lighting	204.5-207.5	0.99	0.000	0.0%	0.000	0.0%	1.851	86.4%	0.117	5.5%	0.175	8.2%	2.143	1.14	1.51	1.78	1.36	1.36	1.723	1.46	97
40.09	Winona Safety	207-212	22.21	0.000	0.0%	0.000	0.0%	3.915	76.5%	0.606	11.8%	0.594	11.6%	5.114	1.14	1.51	1.78	1.36	1.36	1.681	1.46	32
40.10	Country Club & Walnut Canyon	201.5-205.5	8.85	0.000	0.0%	0.000	0.0%	2.165	82.4%	0.153	5.8%	0.309	11.8%	2.627	1.14	1.51	1.78	1.36	1.36	1.706	1.46	17
40.11	Pavement	202-205	12.92	1.244	91.4%	0.000	0.0%	0.102	7.5%	0.005	0.4%	0.010	0.7%	1.361	1.14	1.51	1.78	1.36	1.36	1.190	1.46	5
40.12	Canyon Diablo West Curves	218-220	10.05	0.000	0.0%	0.000	0.0%	1.302	76.5%	0.174	10.2%	0.226	13.3%	1.702	1.14	1.51	1.78	1.36	1.36	1.681	1.46	12
40.13	Canyon Diablo Middle	220-229	13.95	0.000	0.0%	0.000	0.0%	0.941	75.1%	0.149	11.9%	0.164	13.0%	1.254	1.14	1.51	1.78	1.36	1.36	1.675	1.46	15
40.14	Twin Arrows TI	219.5-220.5	4.43	0.000	0.0%	0.000	0.0%	1.366	77.0%	0.172	9.7%	0.236	13.3%	1.774	1.14	1.51	1.78	1.36	1.36	1.683	1.46	20
40.15	Canyon Diablo East Curves	229-230	5.09	0.000	0.0%	0.000	0.0%	0.418	77.0%	0.043	7.9%	0.082	15.1%	0.543	1.14	1.51	1.78	1.36	1.36	1.683	1.46	4
40.17	East Winslow	258-266	10.86	0.000	0.0%	0.000	0.0%	1.916	95.8%	0.056	2.8%	0.029	1.5%	2.001	1.14	1.51	1.78	1.36	1.36	1.762	1.15	24
40.24	Lupton West	345-351	11.86	0.000	0.0%	0.000	0.0%	1.823	98.6%	0.010	0.5%	0.016	0.8%	1.849	1.14	1.51	1.78	1.36	1.36	1.774	1.46	23
40.25	Lupton East	351-360	4.6	0.000	0.0%	0.000	0.0%	0.810	95.7%	0.026	3.0%	0.010	1.2%	0.846	1.14	1.51	1.78	1.36	1.36	1.762	1.46	31
40.26	Lupton TI's	0	9.96	0.000	0.0%	0.000	0.0%	1.242	97.7%	0.016	1.3%	0.013	1.0%	1.272	1.14	1.51	1.78	1.36	1.36	1.770	1.46	8